Newport Research Facility

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NO. 59

Report for the year ended 31st December 2014

This report follows in sequence from the Annual Reports of the Salmon Research Agency of Ireland Inc. and the Salmon Research Trust of Ireland Inc.

Office and Laboratory:
Farran Laboratory, Newport, Co. Mayo.

Telephone: (098) 42300

FAX: (098) 42340

E-mail: newport.reception@marine.ie

Summary

1. The Salmon Research Agency of Ireland merged with the Marine Institute on the 1st July 1999 into Aquaculture & Catchment Management Services and in 2010 the group merged with Fisheries Ecosystem Advisory Services. This report provides a continuation of the data records for the Burrishoole facilities.

2. The total rainfall recorded in Furnace in 2014 was 1723.1 mm. Months of relatively high rainfall in 2014 were January, February, March, May, August and December. Low rainfall was recorded in April, June, July and September. There were 13 days in June and 5 days in July where no rainfall was recorded.

3. The environmental programme was maintained in the catchment with the network of rain gauges, water level recorders and river and lake monitoring stations all in operation.

4. The total release of micro-tagged salmon smolts of Burrishoole reared origin into L. Furnace amounted to 34,703. Smolts were released as six core groups including one SLICE treated group, ranging in mean weight from 46.0g to 58.6g. Smolts were released into Furnace on 1st May 2014. An additional experimental group of 6,210 smolts was also released, 2nd generation derived initially from the progeny of Burrishoole 2SW ova from Delphi hatchery crossed with Burrishoole ranch grilse.

5. In 2007, the Irish Government introduced a cessation of drift netting for salmon at sea and this was continued in 2014.

6. A total of 271 wild grilse and 8 previously spawned grilse (psg) were recorded moving upstream through the permanent traps during the season. The number of spring fish recorded was 26. The total run of wild grilse, including the Furnace rod catch (0), was 271 + 8 previously spawned grilse as determined by floy tag returns.

7. Returning adults were checked for net mark damage; 3.7% (n=242) of wild salmon (mainly in June, July and August) and 6.4% (n=1014) of reared salmon (in July, August and particularly in September) had net marks present.

8. The maximum spawning escapement was 260 wild and 24 reared fish.

9. A total of 8150 wild salmon smolts were recorded in the downstream trap in 2014. The wild return of 2013 smolts as wild grilse in 2014 was 4.5%. The ova to smolt survival at 0.49 – 0.43%.

10. Wild kelt survival was 51.4% and kelt return as previously spawned grilse later in the year was 2.4%.

11. The average return rate of the fish identified as Burrishoole core grilse was 3.23%. For comparison, the return rate of ranched grilse in recent years was 2.9% in 2013 and 4.89% in 2012.

12. A total of 142 wild sea trout and a further 91 non-silvered trout migrated upstream through the traps in 2014. Of the sea trout, 16 were adults and 126 (88.7%) were finnock.

13. The 2014 sea trout smolt run amounted to 427 smolts.

14. The percentage of trout smolts returning as finnock in the same year has historically ranged from 11.4% to 32.4%. In 1989 it collapsed to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's between 4 & 10%, rising to 16.7% in 1999. Finnock return in 2014 was 29.5%, the highest recorded since the mid-1970s.

15. Silver eel trapping continued with the total run amounting to 3118 with the run mainly in October (71%).

16. A total of 48 salmon were caught in the Rod Fishery in 2014, all on Lough Furnace. The catch consisted of 8 wild fish and 40 reared salmon. No wild fish were killed on L. Furnace. There were 53 sea trout reported to be caught on L. Furnace and 19 on L. Feeagh and these were returned alive. 71 brown trout were also reported to be caught on L. Feeagh in 2014.

17. 2014 marked the completion of 24 years of catchment electrofishing surveys for juvenile salmonids and eel.

18. Eel fyke net surveys of Bunaveela, Feeagh and Furnace were undertaken in 2014. The data from these surveys were included in the National eel database.

19. *Anguillicola crassus*, the non-native swim bladder parasite of eel, was recorded in the saline waters of Lough Furnace for the first time in 2011 and again in 2014. Infection intensity has increased year on year. While it has now been found in small eels in the Mill Race channel, it has not been observed to date in eels from the catchment above the traps. This is the first known introduction of an aquatic invasive species into Burrishoole.

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1 Introduction

This report represents a continuation of the scientific aspects of the Annual Reports published by the Salmon Research Agency of Ireland, now integrated them into the Fisheries Ecosystem Advisory Services Group (FEAS) of the Marine Institute. The data presented creates a unique record of fish rearing and wild fish census data for the past 44 years. This data is an essential component in the local, regional and national management of salmon, sea trout and eel and is becoming ever more valuable in the light of increasing pressures on natural stocks, such as exploitation, habitat degradation and global climate change scenarios. The fish monitoring facilities in Newport, along with the reared and ranched salmon stocks held in Burrishoole, are also essential for the evaluation of novel enhancement techniques, alternative stocks and ranching and evaluation of interactions between farmed, ranched and wild strains.

2 Environmental Data

2.1 Mill Race Data

2.1.1 Rainfall

Daily meteorological data were collected during 2014 at the manual Met Station in Furnace. The monthly rainfall figures for 2011, 2012, 2013 and 2014 are given in Table 2.1, along with the annual totals for the years 1977 to 2014. Months of relatively high rainfall in 2014 were January, February, March, May, August and December. Low rainfall was recorded in April, June, July and September. There were 13 days in June and 5 days in July where no rainfall was recorded. The total rainfall was 1723.1mm in 2014. Daily rainfall amounts are shown in Figure 2.1.

Table 2-1: Monthly rainfall totals (mm) for the Furnace Station in 2011, 2012, 2013 and 2014 and the annual totals for 1977 to 2014.

Month	2011	2012	2013	2014	Year	Total	Year	Total
January	93.4	186.0	208.9	295.9	1977	1579.7	2000	1833.2
February	192.7	169.0	94.3	252.7	1978	1592.2	2001	1298.7
March	82.6	70.7	60.4	125.3	1979	1653.3	2002	1715.9
April	89.2	92.9	126.2	52.1	1980	1792.1	2003	1353.2
May	161.1	78.0	159.4	131.7	1981	1646.8	2004	1641.3
June	96.1	178.7	64.8	60.9	1982	1609.6	2005	1608.2
July	40.5	111.1	85.3	87.7	1983	1495.9	2006	1550.7
August	135.1	113.1	101.6	116.0	1984	1556.6	2007	1576.8
September	199.1	196.0	93.9	15.4	1985	1584.1	2008	1805.0
October	276.7	118.4	111.3	158.8	1986	1886.9	2009	1793.9
November	167.0	175.3	90.5	134.6	1987	1373.6	2010	1311.6
December	293.4	187.2	195.2	292.0	1988	1715.2	2011	1826.9
					1989	1583.9	2012	1676.4
Total	1826.9	1676.4	1391.8	1723.1	1993	1473.4	2013	1391.8
					1994	1757.1	2014	1723.1
					1995	1382.5		
					1996	1286.6		
					1997	1351.6		
					1998	1830.9		
					1999	1949.1		

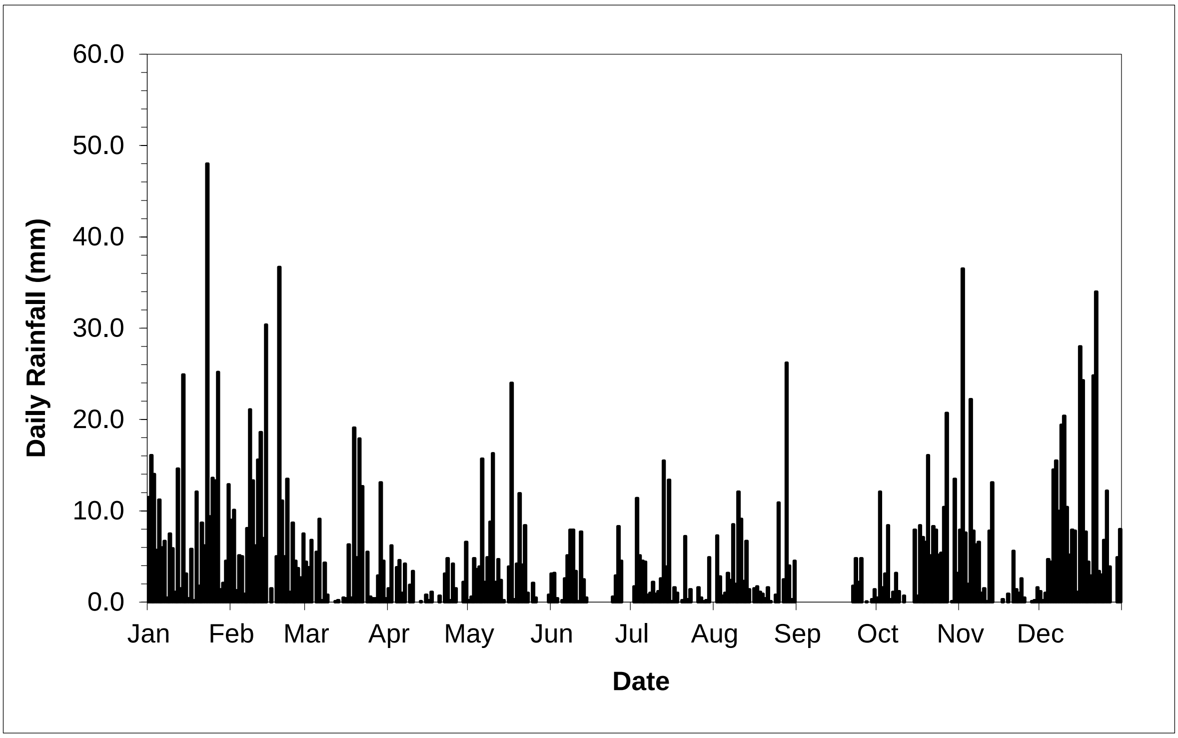


Figure 2-1: Daily rainfall amounts (mm) recorded in the Mill Race manual weather station in 2014.

2.1.2 Water Level and Temperature

Water Level: Difficulties were experienced in 2003 with the automatic water level chart recorder which had been in place since before 1970. An OTT Orphimedes automatic water level recorder was installed in late January 2004 and data from this sensor are presented here. Water levels are recorded every 15 minutes and are presented in Figure 2.2 recorded at 00:00 hrs.

The plot in Figure 2.2 shows a number of periods of low water, with drought periods in July-August and September-October. Two large floods occurred in October and December. The period of low water in the summer interfered with the upstream migrations and the September - October low water interfered with the timing of the silver eel run.

Water Temperature: In 2004, a TidbiT temperature logger was installed along with the chart recorder and this records water temperature every 30 minutes. In 2009, this was upgraded to an OTT Orpheus mini sensor and logger. The temperature logger data are presented in Figure 2.3, recorded at midnight.

In 2014, water temperatures (recorded at midnight) fell to a minimum of 4.6^{0}C on the 15th February. There was then a fairly steady increase in temperature mid-June to a peak of 18.9^{0}C. This dropped back to 16+^{0}C and then there was a further warm spell of weather which increased water temperature to a peak of 19.7^{0}C in late July. The temperature dropped fairly steadily from late July for the rest of the year, with a steady warm period in September, to 6.8^{0}C at the end of December.

Note: A problem was encountered with the temperature TidBit data recorded from July 2010 to 2013. It was decided that the temperature data collected by the OTT Orpheus sensor at the same location was more reliable and the database will be update accordingly. The 2014 data presented in this report was collected by the Orpheus sensor.

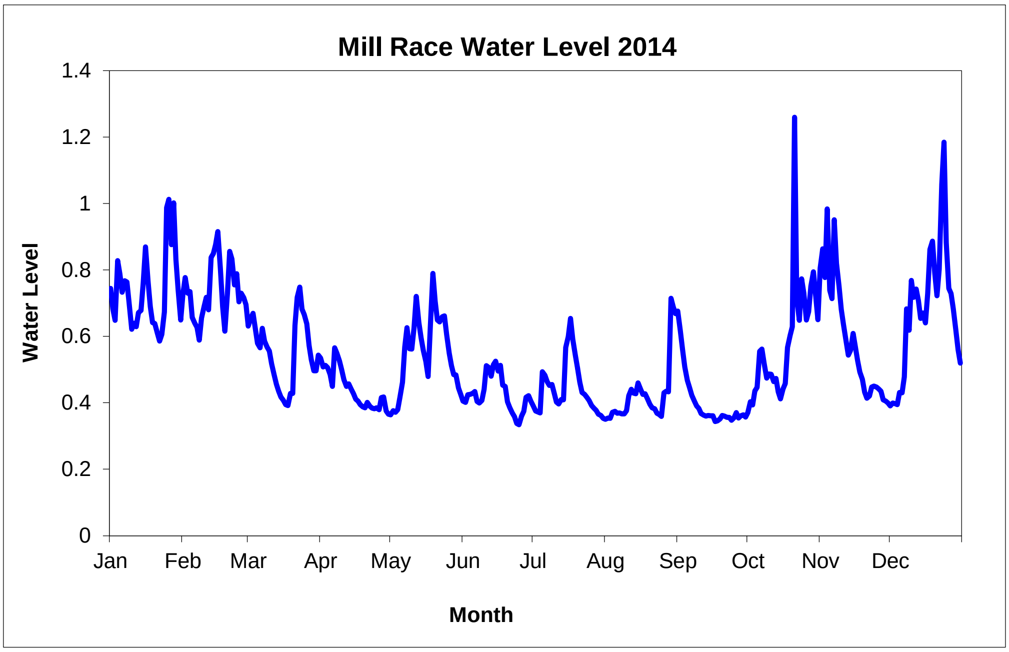


Figure 2-2: Water levels recorded at mid-night for the Mill Race using an OTT Orphimedes automatic water level recorder.

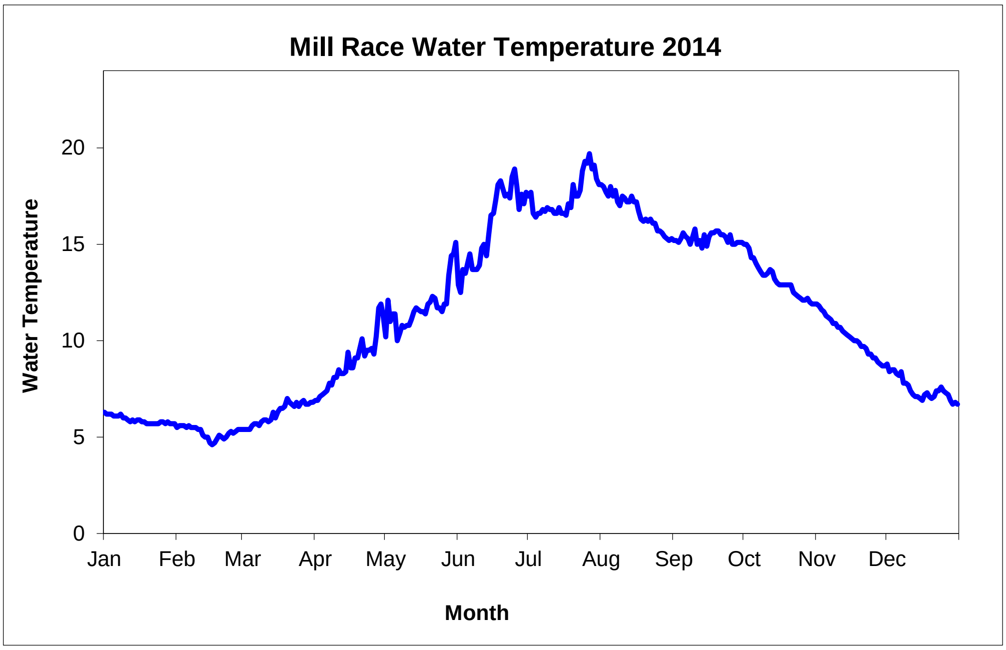


Figure 2-3: Water temperatures (°C) recorded, by OTT Orpheus mini sensor and logger, at mid-night for the Mill Race.

2.2 Catchment Programme

2.2.1 Background

Over the last twenty years, the Marine Institute has developed a monitoring programme in the Burrishoole catchment, with the aim of ensuring a long term ecological record against which changes in fish biology can be assessed. At the centre of the monitoring program are a series of automatic monitoring stations which measure key aquatic parameters at high frequency. These automatic stations include two lake stations (AWQMS), which have various meteorological instruments included with a suite of underwater temperature and water chemistry sensors, and three river stations, (ARMS), which are equipped with sensors for measuring water temperature, water level, pH, conductivity, dissolved oxygen, and turbidity. The automatic monitoring stations are also equipped with telemetry systems for relaying high-resolution data back to the laboratory. The data from the lake and river stations are complemented by spot samples analysed for water colour, turbidity, Total Phosphorus, Total Nitrogen and ethanol extracted chlorophyll *a*. In addition, the Institute has deployed core-funded instrumentation including temperature loggers, water level recorders and data-logging rain gauges in the Burrishoole, Owengarve and Owenduff catchments. These instruments allow high-resolution patterns of rainfall to be linked with stream flow. An important feature of the monitoring network is the ability to collect simultaneous data from river, lake, and climatic instruments.

In the last decade, the physical, chemical and meteorological data have been supplemented with biological datasets describing zooplankton and phytoplankton assemblages in Lough Feeagh and Lough Furnace, along with macroinvertebrate species occurrence and abundance from 16 index sites.

2.2.2 The 2014 Programme

The maintenance and development of long term physical, chemical and biological datasets characterising the freshwater component of the Burrishoole catchment continued in 2014. Regular downloads of remote equipment, as well as routine maintenance and replacement of broken equipment, were carried out at all sites. Considerable efforts were continued in 2014 to enhance the usability of the high frequency data, by development and maintenance of relevant rating curves and instrument calibration.

2.2.3 The Black River

The main river flowing into Lough Feeagh is the Black River, also known as the Shramore River. A water level recorder is situated approximately 500m above the lake. Figure 2.4 shows the average daily water level and Figure 2.5 shows the average monthly water levels from 2002 to 2014. It is immediately apparent that the three years, 2011, 2012 and 2013 have been uncharacteristically wet, with water levels rarely dropping to base flow while 2014 levels reflect the drier year with mean levels dropping again.

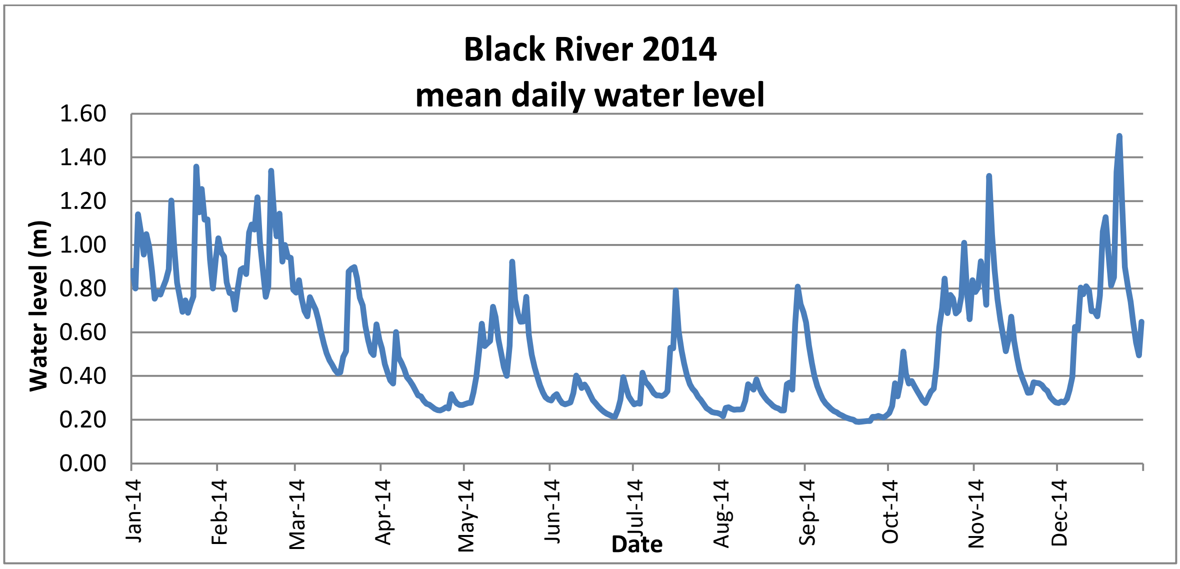


Figure 2-4: Mean daily water level for the Black River, 2014.

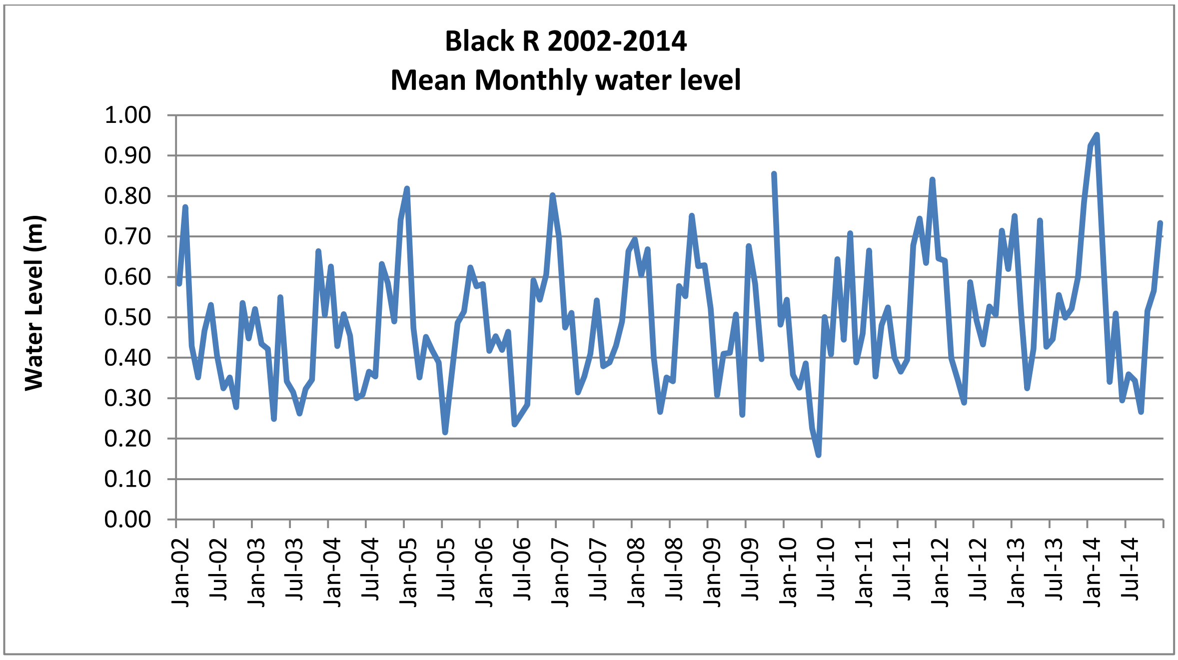


Figure 2-5: Monthly mean water levels for the Black River, 2002-2014.

2.2.4 Lough Feeagh

Lough Feeagh is situated in the Burrishoole catchment in the west of Ireland close to the Atlantic coast and is therefore strongly affected by the temperate oceanic climate that predominates in the region. The water is soft and highly coloured (2014 mean of 65 mgl^{-1} PtCo), and is oligotrophic, with Chlorophyll *a* ranging between 1 and 2μg l^{-1}. Mean annual Total Phosphorous is 8.6 μg l^{-1} (2012) and Total Nitrogen is 0.37mgl^{-1} (2012). The Lough Feeagh Automatic Water Quality Monitoring System (AWQMS) measures various parameters using a Hydrolab Datasonde 5, two

Chelsea scientific minitrackas and a Seapoint fluorometer (pH, dissolved oxygen, temperature and conductivity, turbidity, Chl and CDOM fluorescence). These parameters are measured every two minutes and an hourly average is calculated for all the parameters. There is also a thermister chain and various weather instruments continually monitoring variables such as barometric pressure, wind speed and wind direction.

The Lough Feeagh AWQMS operated well in 2014, with only one short time period of missing data. The temperature profile indicates lake stratification at the start of June and mixis in October as normal (Fig. 2.6). Spring 2014 was relatively cold, similar to 2013, but the summer stratification lasted longer (Fig. 2.7).

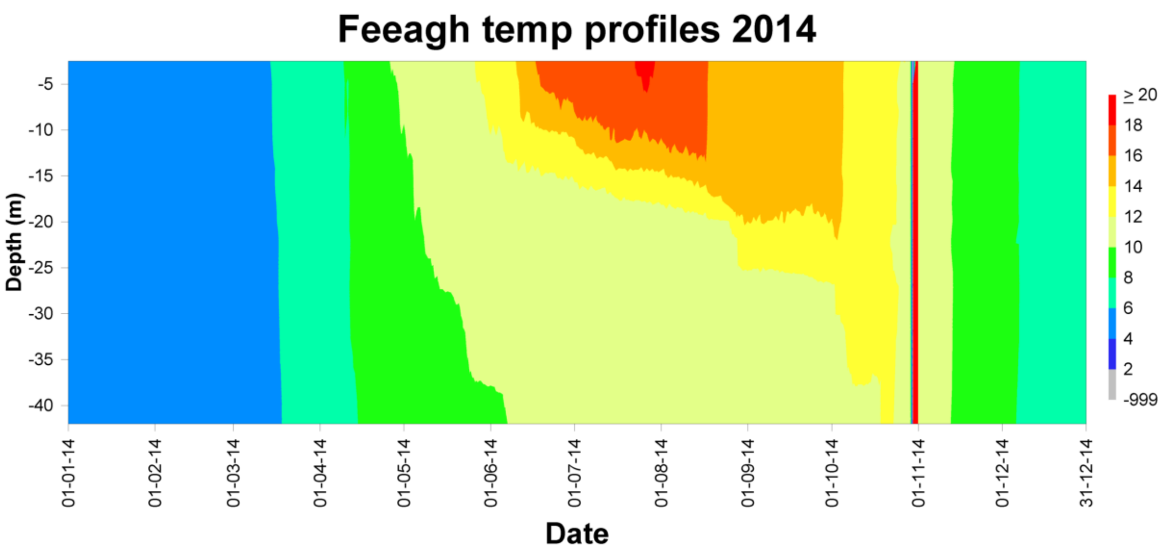


Figure 2-6: Temperature profile for L. Feeagh measured using PRT sensors on the AWQMS for 2014. The grey denotes missing data.

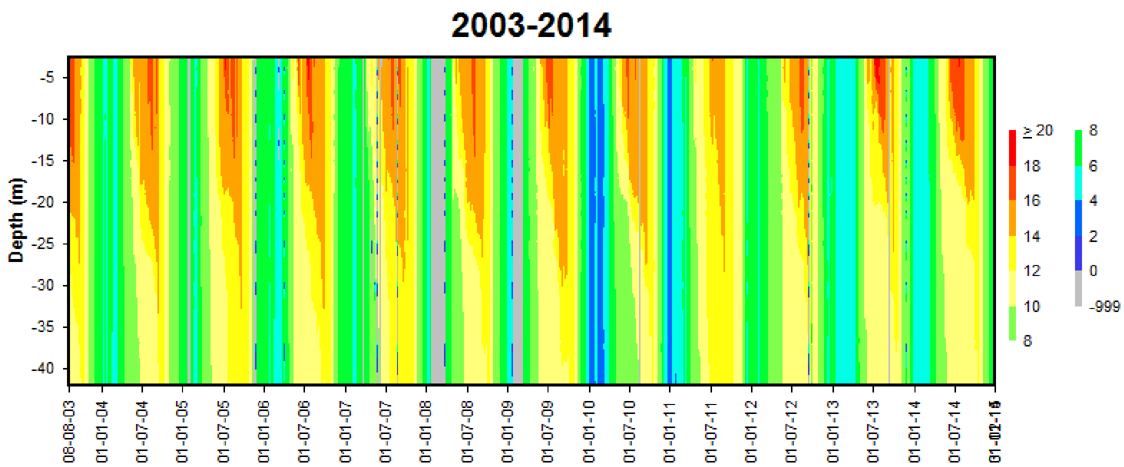


Figure 2-7: Temperature profiles for L. Feeagh measured using PRT sensors on the AWQMS for 2003-2014. The grey denotes missing data.

2.2.5 Lough Furnace

Lough Furnace is situated in the lower end of the Burrishoole catchment. Lough Furnace, (2km from north to south at its widest point, covering an area of 170ha, max depth is 21m with an average depth of 7m) is a cryptodepression tidal lagoon lake. Sea water enters the lake during spring tides but the freshwater exchange ensures relativity low salinities at the surface throughout the year. The lough is thermally stratified throughout the year with spring and autumn inversions and accompanying halo- and oxyclines. Monitoring of L. Furnace commenced in the early 1970s and automatic daily monitoring commenced in May 2008. This AWQMS (Fig. 2.8) has a Datasonde DX5 attached to a profiling winch, enabling temperature, conductivity, dissolved oxygen (% and mg/l), salinity and pH profiles of the lake to be taken. The winch profiles the lake 4 times a day (6am, noon, 6pm and midnight), taking four hours to run a profile and is parked for two hours. There is also a nephelometer and fluorometer positioned one meter below the water column. All parameters are measured every two minutes and an hourly average is then calculated. A weather station is also fully functional on the AWQMS measuring wind direction, wind speed, radiation, relative humidity and barometric pressure. The winch on the AWQMS was taken out of service at the end of October 2014, to allow for a major upgrade.

Figure 2-8: The Automatic Water Quality Monitoring Station (AWQMS) on L. Furnace (left) and the meteorological instruments attached (right)

Lough Furnace exhibited anoxia below 5 metres for most of 2014 (Fig. 2.9-10). There was some replenishment of the hypolimnion with oxygenated water in early October, coinciding with a very shallow epilimnion and isothermal conditions through the water column. As in other years, the main algal productivity occurred just above the halocline during the spring and summer (Fig. 2.10).

Six years of continuous data from the AWQMS on Lough Furnace have now been collected, and show that there have been three instances of refreshing of the hypolimnion with oxygenated water (March 2010, April/May 2013 and October 2014) (Fig. 2.11). Similar to Lough Feeagh, the summer temperatures of 2014 in the epilimnion were considerably warmer than previous years (Fig. 2.11). When taken in the context of several years of data, it can now be seen that the deep freshwater layer over the winter of 2011/2012 (when the halocline persisted around 6 metres) was mirrored by the winter of 2013/2014, but that the halocline is generally present at around 4 metres or less (Fig. 2.12). The late summer and early autumn of 2014 appears to have had an exceptionally shallow epilimnion, with high salinity, low oxygen and isothermal conditions prevailing. This resulted from very low rainfall in the catchment. Finally, the Chlorophyll fluorescence indicates a relatively strong spring bloom in 2014, and similar to other years, the main biomass of algae appeared to occur in the mixed layer between the hypolimnion and epilimnion (Fig. 2.12).

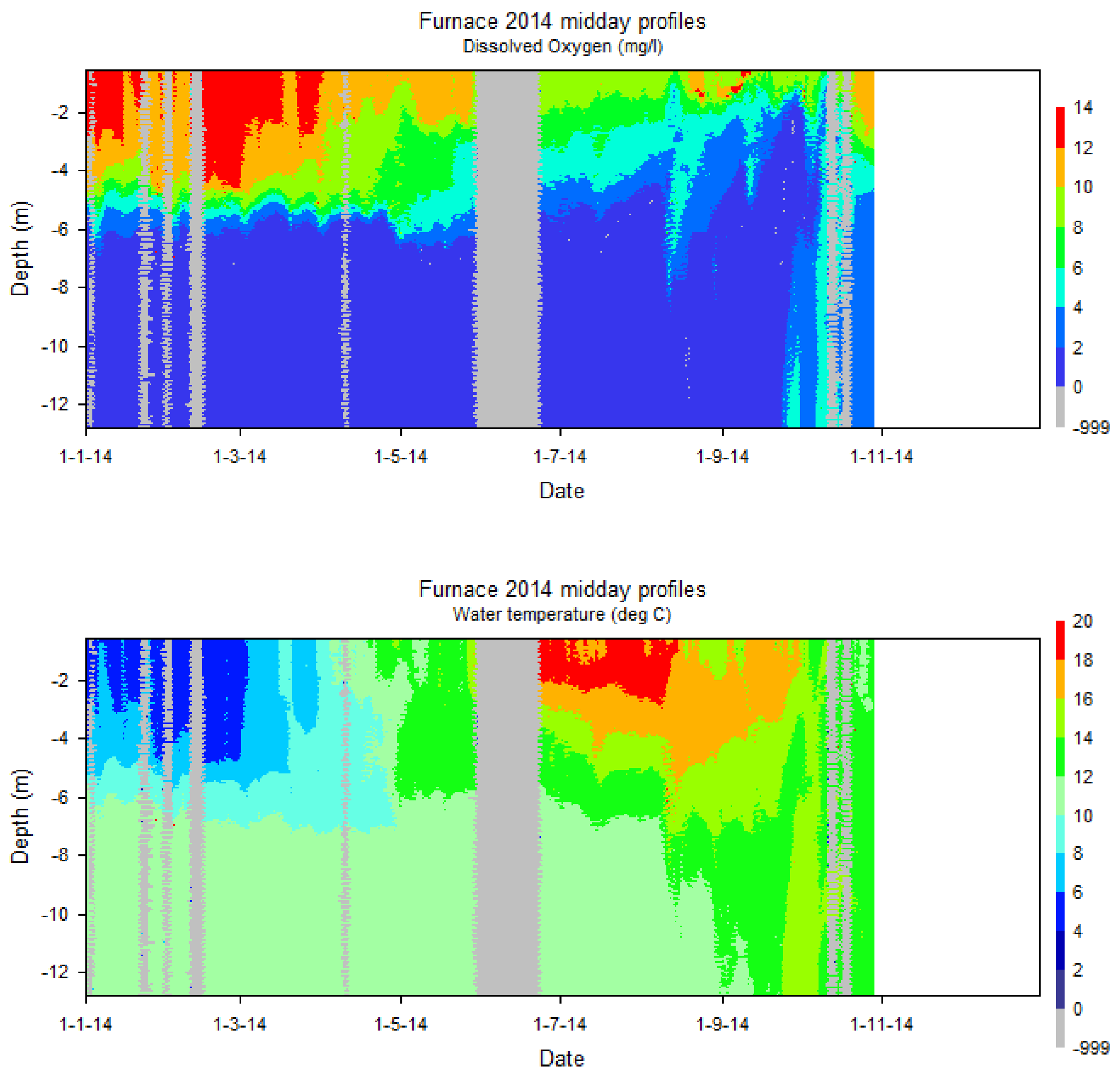
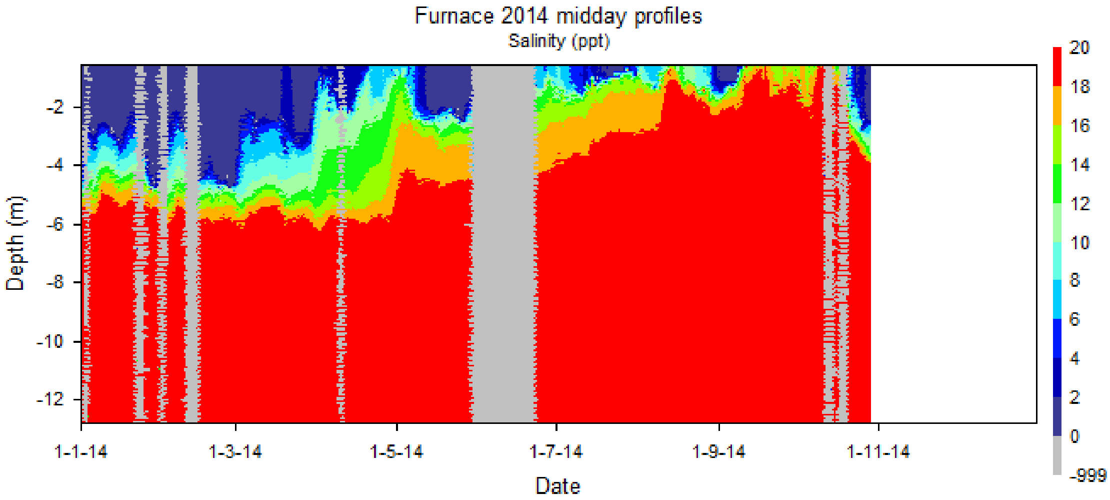


Figure 2-9: Oxygen (top) and temperature (bottom) profiles from Lough Furnace, 2014. Grey indicates missing values.



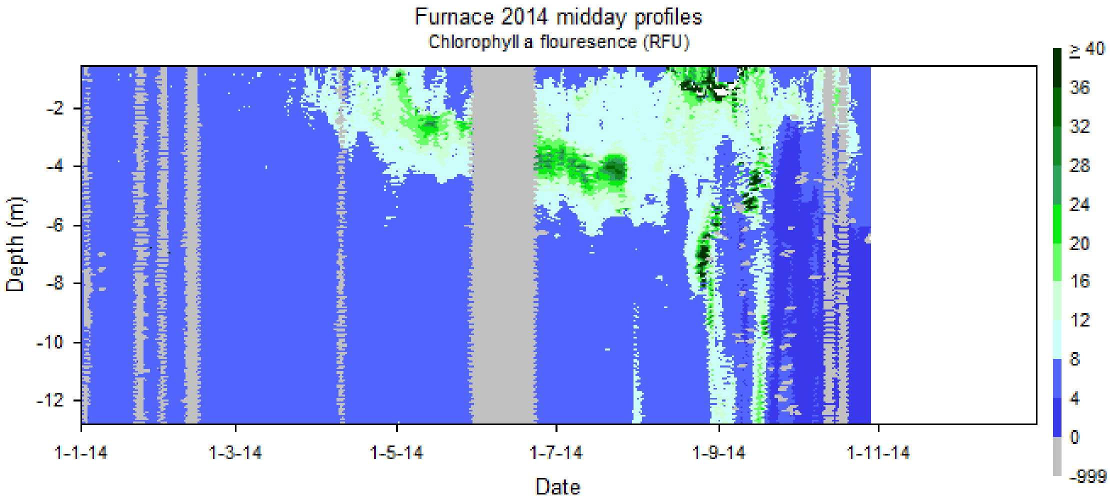
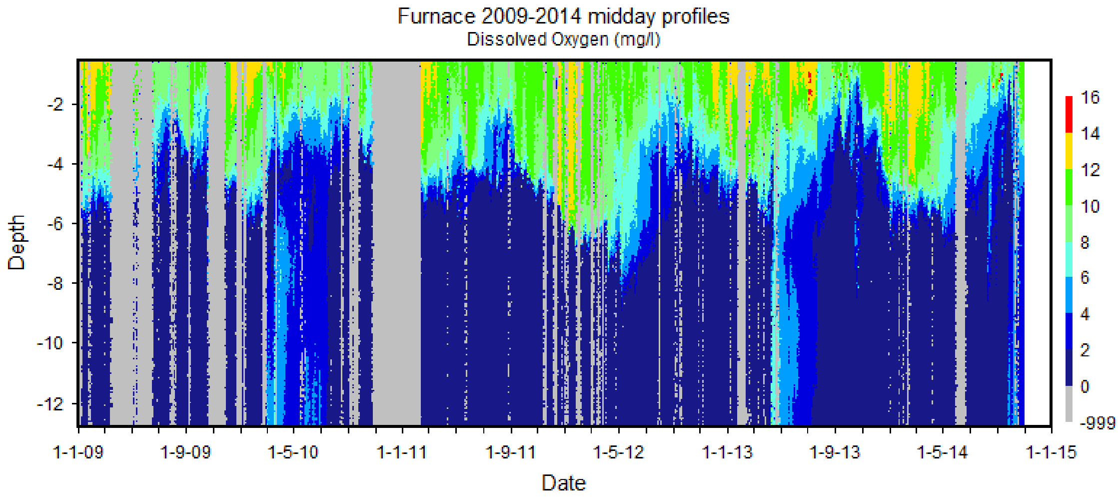


Figure 2-10: Salinity (top) and Chlorophyll *a* (bottom) profiles from Lough Furnace, 2014. Grey indicates missing values.



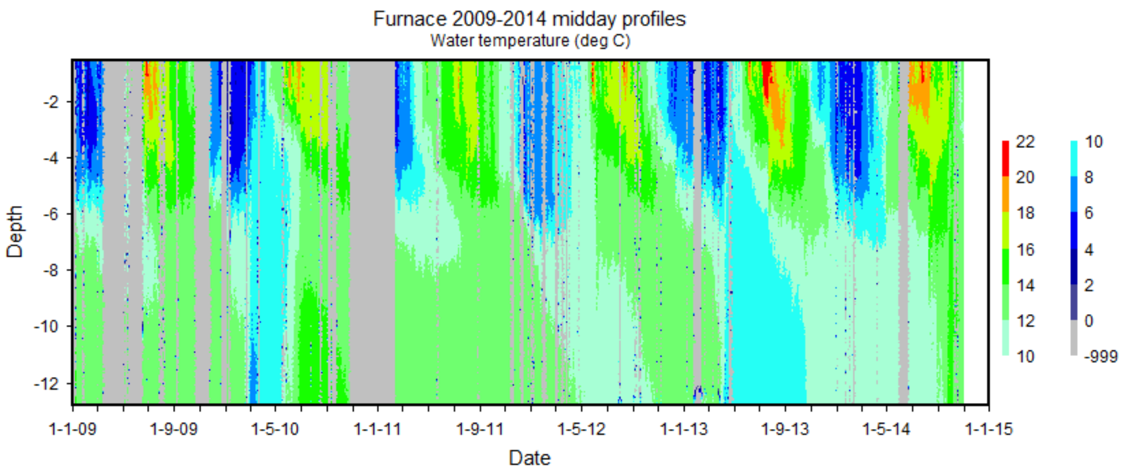


Figure 2-11: Oxygen (top) and temperature (bottom) profiles from Lough Furnace, for 2009 to 2014. Grey indicates missing values.

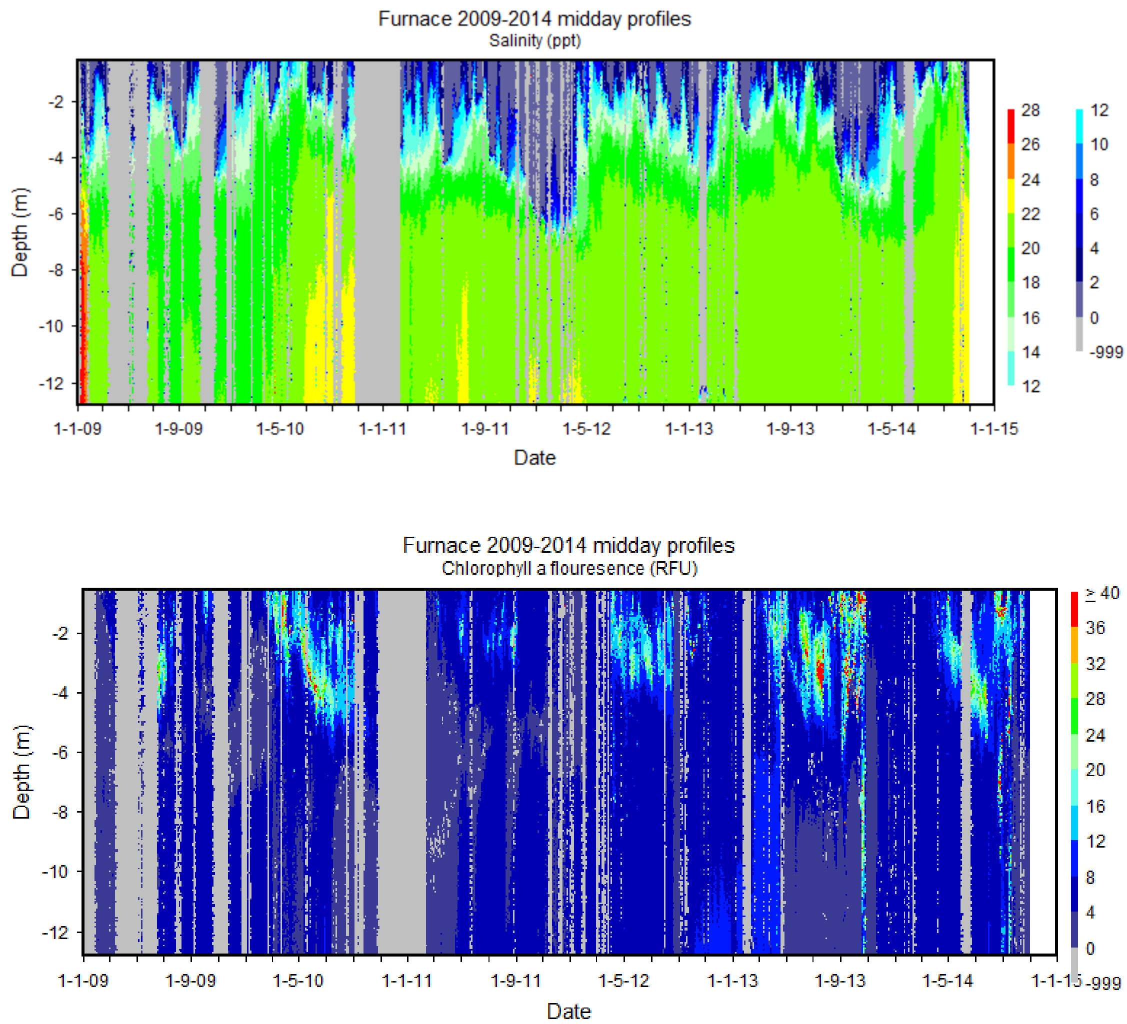


Figure 2-12: Long term Salinity (top) and Chlorophyll *a* (bottom) profiles from Lough Furnace, for 2009 to 2014. Grey indicates missing values.

3 Salmonid Rearing

3.1 Salmon Stocks 2013

3.1.1 Ranching

In January 2014, a batch of surplus salmon pre-smolts were transferred to Screebe Hatchery for ranching purposes.

The total release of microtagged smolts of ranched Burrishoole grilse origin into Lough Furnace was 34,703. Six tag groups, including one group treated with 'SLICE' for protection against lice infestation during early migration, were released on 1st May 2014. Mean weights ranged from 46.0 to 58.6 gms, somewhat smaller than usual as a consequence of low spring water temperatures in 2013. One experimental group of 6,210 microtagged and T branded smolts (2nd generation derived from the progeny of Burrishoole 2SW ova from Delphi hatchery crossed with Burrishoole ranch grilse) was also released on 1st May 2014, with an average weight of 57.5 gms. A small group of salmon smolts (500) were retained for a sentinel cage experiment and transferred on 30th May 2014.

Tag code details are shown in Table 5.1.

3.2 Salmon Stocks 2014

There was no commercial salmon production in 2014. An estimated 64,600 Burrishoole ranch eyed ova from six stripping dates were retained for ongrowing. Water temperatures were favourable at first feeding with daily averages ranging from 9.15^{0}C in mid-April to 10.65^{0}C in early May when the last group commenced feeding. Growth and survival were good with an overall survival of 91.7% from first feeding to grading in August. Ranch salmon were mixed in October 2014 to produce core medium and large grade release groups. Stock remaining in December 2014 was 36,213.

3.3 Salmon Stocks 2015 (Grilse ova laid down in 2014/'15)

An estimated 66.2% of all returns (65% of ranch grilse returns and 79.1% of 2SW returns) were processed between May and August. Predator damage was estimated to be 3%.

Broodstock collection commenced on 15th August and salmon were held in ponds until transfer to the broodstock holding pond on 19th September 2014 (82 males, 108 females). Broodstock collection continued into December and in total, 399 ranch adults (203 females, 196 males) were held during the stripping period.

Average water temperatures decreased from 8.5^{0}C to 6.5^{0}C during December and early January. Salmon were sorted weekly, over a six week period (December 2nd to January 14th 2015), to recover ripe females for egg production. In early December, many of the males were found to produce little or no milt, but milt production improved over time. On completion of stripping in January, the majority of remaining fish were culled but a subsample of the 42 unripe females remaining was retained to assess their potential for spawning at a later date. It is estimated that approximately 55% of females retained until 5th February were ripe at this stage and eggs were in good condition.

An estimated 505,000 green ova were produced by 154 females. The average fecundity value was 3,260 ova per grilse female (n=114) and 4,244 ova per 2SW female (n=3). A proportion of each family, from confirmed Burrishoole stock, was retained in the hatchery from each of the eight stripping dates, totalling 64,600 eyed ova from 148 females (including 3 2SW) and 157 males (including1 2SW). Ova quality and survival was good.

Broodstock condition was good throughout the holding period. Thirty ranch salmon broodstock were sampled in January 2015 and subsequently certified by the Marine Institute Fish Health Unit as disease free. During 2014, 23 salmon (with predator damage) were examined to assess the incidence of Anasakis and post larvae of the cestode *Hepatoxylon trichiuri*. Anasakis was observed in 87% of fish sampled. Levels were recorded as low (< 10 per fish) in 90% and medium (10-50 per fish) in 10% of sampled fish. The presence of cestodes (1 or 2) in the body cavity was noted in 13% of fish sampled.

3.4 Acoustic Tracking Programme

Field work for the acoustic tagging programme (2013-2014), which aims to examine behavioural differences and environmental preferences of wild and ranch adult salmon returns in Lough Feeagh, was completed in April 2014. The programme aimed to examine behavioural differences and depth preferences of wild and ranch adult salmon returns in Lough Feeagh.

In July 2013, eight receivers were moored in Lough Feeagh, providing close to full coverage of Lough Feeagh, and two receivers were placed in the Black river. Fifteen salmon were tagged with Vemco acoustic temperature/depth or depth tags between 25th June and 23rd September 2013. A scatter graph showing depth records for one wild female spring fish, tagged on 25th June 2013 and recovered in the downstream trap on 8th April 2014 is shown in Figure xxx. Note the behaviour observed during July 2013, when surface water temperatures increased to above 20°C, whereby the fish tended to avoid the warmer surface waters for an extended period. The main spawning period is considered to be from December 12th to 20th 2013.

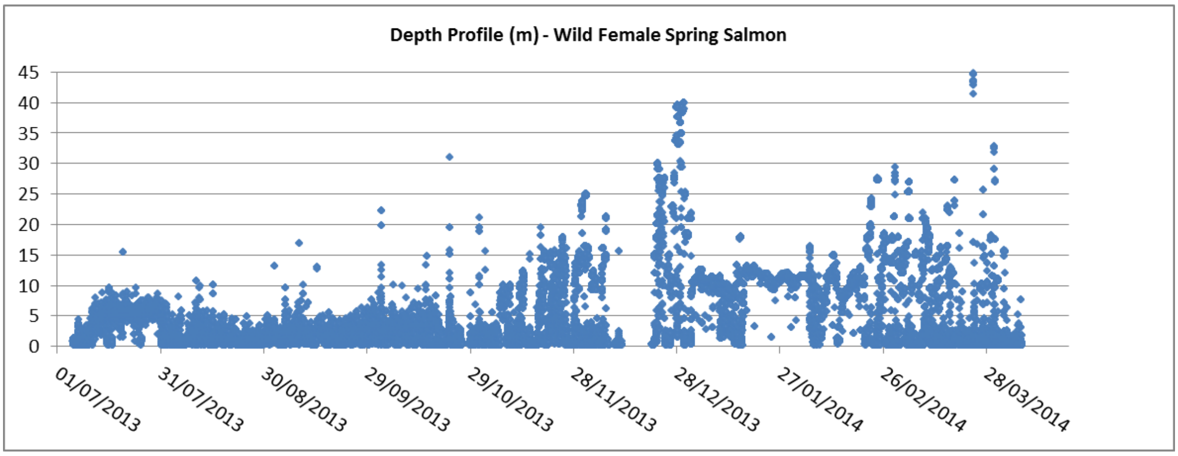


Figure 3-1: Scatter plot showing depth records for an acoustically tagged female spring fish in Lough Feeagh from July 2013 to April 2014.

4 Salmon Census Programme

The salmon census and stock assessment programme was continued in 2014 with a full upstream and downstream census of migrating wild salmon. The data provides a valuable index of salmon survivals and stock dynamics for the freshwater components of the stock.

4.1 Wild Salmon and Grilse

A total of 271 wild grilse, and 8 previously spawned grilse, were recorded moving upstream through the permanent traps during the season (Table 4.1). The first grilse was recorded on May 27th, water levels were low for much of June and short periods of rainfall during the middle and end of the month resulted in a total of 32 grilse recorded in June. The main run of grilse occurred during July when 167 fish were recorded. However although additional grilse were recorded through to December the overall total of 271 fish was low. The low survival of 2013 smolts returning in 2014 was also reported from other systems around Ireland and across the north Atlantic.

A total of 257 grilse were recorded in the Salmon Leap trap and 14 grilse in the Mill Race trap.

The total number of spring fish recorded in the upstream traps was **26**.

The total wild grilse return to fresh water was **271** and **8** previously spawned grilse.

Table 4-1: Monthly wild grilse totals for the Salmon Leap and Mill Race traps, 2014.

	Mill Race	Salmon Leap	Total	%
May	0	1	1	0.4
June	0	32	32	11.8
July	6	161	167	61.6
August	3	49	52	19.2
September	0	2	2	0.7
October	1	12	13	4.8
November	3	0	3	1.1
December	1	0	1	0.4
	14	257	271	100

Table 4-2: Monthly proportions (%) of the wild grilse run timing 2004-2014.

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
May	0.0	0.4	0.5	0.3	0.0	0.0	0.0	0.2	0.1	0.7	0.4
June	36.0	23.9	1.4	7.7	9.1	4.6	0.9	16.8	29.8	13.2	11.8
July	41.0	13.2	40.1	56.3	17.9	78.7	75.8	43.4	57.1	45.0	61.6
August	9.8	39.1	31.9	17.5	62.6	15.5	15.5	29.8	10.1	26.6	19.2
September	10.9	14.8	22.8	14.9	7.3	0.9	6.7	8.4	2.4	10.3	0.7
October	1.0	5.5	2.5	1.0	2.9	0.2	1.0	0.6	0.4	2.6	4.8
November	0.7	3.0	0.5	1.3	0.2	0.2	0.1	0.8	0.0	1.6	1.1
December	0.5	0.2	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4

Table 4-3: Wild salmon, grilse and previously spawned grilse (PSGs identified from floy tag recoveries) totals in the upstream traps, 1970-2014.

Year	Total Salmon	Total Grilse	Previously Spawned Grilse
1970-74	14	1145	
1975-79	36	703	
1980-84	35	449	
1985-89	22	492	
1990-94	16	421	
1995-99	12	509	
2000-'04	12	542	
2005-'09	22	642	
1995	15	582	
1996	18	409	
1997	6	538	
1998	4	516	
1999	16	502	
2000	6	568	
2001	6	368	
2002	2	648	
2003	18	544	
2004	28	580	
2005	9	532	
2006*	31	530	
2007*	12	1049	
2008	23	548	21
2009	37	549	10
2010	17	686	17
2011	50	523	7
2012	18	671	6
2013	23	710	15
2014	26	271	8

* years where the grilse count was raised to account for loss in the traps.

4.2 Net marked fish in upstream traps

In 2007, the Irish Government introduced a cessation on drift netting in Irish coastal waters. The overall incidence of net marks recorded since the cessation in 2007 remains very low.

The overall incidence of net marks in 2014 on wild and ranched fish was the highest since 2007. The incidence of net marks on wild fish increased from 2.8% in 2013 to 3.7% in 2014 and ranched fish from 1.8% to 6.4% for the same period. The highest monthly occurrence for wild fish occurred in August with 4.4% and in September for ranched at 11.8%.

Table 4-4: Percentage occurrence of net marks on wild and reared salmon, 2014.

	Wild Grilse %	n for wild/month	Reared Grilse %	n for reared/month
May	0.0	1	0.0	1
June	3.1	32	0.0	32
July	4.1	146	9.0	456
August	4.4	45	4.6	329
September	0.0	2	11.8	76
October	0.0	12	0.0	112
November	0.0	3	0.0	8
December	0.0	1	0.0	0
Total	3.70%	242	6.41%	1014

4.3 Wild Spawning Stock

The spawning stock (escapement) represents the number of fish available for spawning. It is calculated by subtracting rod caught fish and downstream-displaced fish as well as losses due to poaching, disease and predation, which have been estimated at 5% for wild fish and 10% for reared fish not displaced downstream.

In both 2006 & 2007, an additional number of fish, reared and wild, escaped upstream undetected (see previous reports). It is likely that the wild grilse count for those years were minimum figures and this was taken into account for all calculations based on the 2006 & 2007 spawning escapements.

4.3.1 Spawning escapement and stock

The total spawning stock in 2014 consisted of 260 wild fish and 24 reared fish (Table 4.5). The reared component was derived from 117 reared fish which were released upstream between June and September to provide an early component of reared returns for broodstock. A total of 90 reared fish were recaptured in the downstream traps prior to the spawning season of which 86 fish were retained as broodstock. The very low wild spawning stock in 2014 is a direct consequence of the poor marine survival to freshwater. This was the second lowest spawning stock recorded, the lowest, was recorded in 1990 with a wild spawning stock of 213 fish.

Table 4.6 gives the annual total spawning escapement, the wild escapement and the reared fish component. The spawning escapement of wild fish in 2007 was the highest observed over the last two decades. Particularly poor wild escapement was recorded in the 1990s and in 2001.

Table 4-5: Spawning stock of salmon and grilse, 2014.

	Wild grilse (1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	271	26	117
Rod Feeagh	0	0	0
Culled	3	0	3
Broodstock	0	0	86
Estimated morts.	12	1	3
Displacement	20	1	1
Spawning stock	**236**	**24**	**24**

* See Chapter 4.3.2.

Table 4-6: Spawning escapement, 1970-2014.

	Maximum spawning escapement	Wild fish component	Reared fish component
1970-74	1126	986	140
1975-79	725	683	42
1980-84	474	430	44
1985-89	662	428	232
1990-94	603	348	254
1995-99	519	428	95
2000-'04	516	494	21
2005-'09	624	587	38
1995	464	376	102
1996	594	355	239
1997	494	466	28
1998	498	456	42
1999	547	485	62
2000	567	527	40
2001	370	349	21
2002	570	562	8
2003	517	506	11
2004	554	528	26
2005	503	472	31
2006	552	520	32
2007	1038	958	80
2008	512	495	17
2009	517	489	28
2010	652	617	38
2011	548	512	36
2012	668	640	28
2013	702	691	11
2014	284	260	24

4.3.2 Wild salmon broodstock stripped December 2014

No wild fish were stripped in 2014.

4.4 Survival from Ova to Grilse

The relevant brood year for the 2014 grilse was 2010 with ova hatched in 2011 and smolt migration in 2013 (Table 4.7).

As in previous years, it has been assumed for the purpose of estimating survival that ranched grilse spawned naturally. Specific data are not currently available on differential survival rates of wild and ranched stocks spawned in the wild. All relevant calculations are based on parameters set out in the Ann. Rep. No. 19, 1974.

Table 4-7: Survivals from ova to smolt and smolt to grilse.

Spawning escapement in 2010	652
No. of females	326 - 359
Ova deposition	1,304,000 – 1,477,285
No. of smolts in traps 2013	6357
No. of smolts released	5960
Survival ova to smolt*	0.49 – 0.43
No. returning grilse 2014	271
Survival smolt to grilse	4.5%
Survival to grilse per grilse female	***0.83 – 0.75***

* two estimates of the % females in the run using 50% and 55%

4.5 Ova to Smolt Survival

The survival of ova to smolt recorded in 2014 was 0.5 from a spawning escapement of 652 adults. For the five years prior to 2007 the average spawning stock was 539 and the average survival of ova to smolt was 0.7.

There was a considerable decrease in the percentage return of grilse from 10.5% (2012) to 9.4% (2013) to 4.5% in 2014 from a released wild smolt migration of 5960. The survival to grilse per grilse female was 0.83 – 0.75 (Table 4.8).

Table 4-8: Percent survivals for ova to smolt and grilse per female grilse spawner; comparative data for 5-year averages from 1970-1989 and values for the individual brood years from 1990 onwards.

Brood year-class	% survival rates ova to smolt	survival rates to grilse per grilse female spawner
1970-74	0.48 - 0.62	1.4 - 1.7
1975-79	0.63 - 0.73	1.5 - 1.7
1980-84	0.61 - 0.69	1.7 - 1.9
1985-89	0.44 - 0.45	1.4 - 1.5
1990	0.47 - 0.54	1.8 - 2.0
1991	0.47 - 0.53	1.8 - 2.0
1992	0.48 - 0.54	1.3 - 1.5
1993	0.39 - 0.45	1.5 - 1.6
1994	0.36 - 0.41	1.3 - 1.4
1995	0.83 - 0.93	1.9 - 2.1
1996	0.53 - 0.61	1.8 - 1.9
1997	0.52 - 0.59	1.4 - 1.5
1998	0.58 - 0.60	2.4 - 2.6
1999	0.79 - 0.70	1.8 - 2.0
2000	0.56 - 0.64	1.9 - 2.1
2001	1.30 - 1.10	2.9 - 2.6
2002	0.56 - 0.64	1.7 - 1.9
2003	0.68 - 0.76	3.7 - 4.1
2004	0.53 - 0.60	1.8 - 2.0
2005	0.69 - 0.61	2.0 - 2.2
2006	0.75 - 0.67	2.4 - 2.6
2007	0.34 - 0.30	0.9 - 1.0
2008	0.65 – 0.57	2.4 - 2.6
2009	0.75 – 0.66	2.7 - 2.5
2010	0.49 – 0.43	0.8 - 0.8

4.6 Wild Salmon Smolts

A total of 8150 smolts were recorded in the downstream traps in 2014 (Table 4.9). The first smolts were recorded on March 27th.. However, water levels remained low until the end of April. The main run was recorded in May during which 6490 smolts were recorded. The peak of the run occurred between the 4th and 15th of May when 69% of the total run was recorded (Figure 4.1).

The total numbers of wild salmon smolts decreased from 7717 in 2012 to 6355 in 2013 and increased to 8150 in 2014. (Table 4.10).

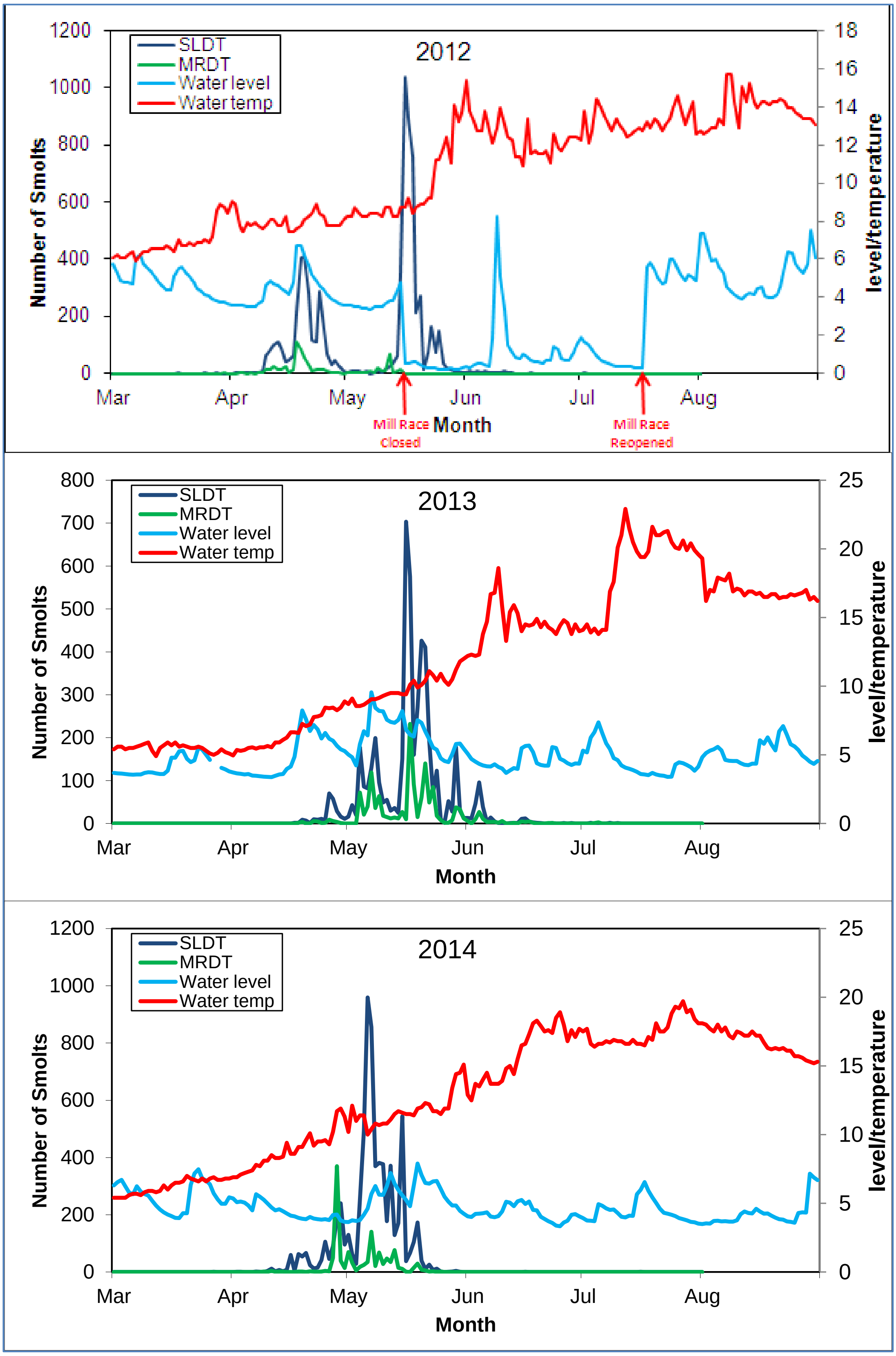


Figure 4-1: Timing of the 2012, 2013 and 2014 wild salmon smolt runs in the Salmon Leap and Mill Race traps with daily midnight water level (m x 10) and midnight temperature (^{0}C). Note Mill Race closed with a dam at the upstream end from 16h May to 17th July 2012.

Table 4-9 : Number of wild salmon smolts counted in 2014.

Month	Salmon Leap Down Trap	Mill Race Down Trap	Total
March	1	0	1
April	1152	505	1657
May	5792	698	6490
June	1	0	1
July	1	0	1
August	0	0	0
September	0	0	0
Total	6947	1203	8150

Table 4-10: Annual numbers of wild salmon smolts recorded in the downstream traps.

Year	1990-94	1995-99	2000-04	2005-09	2008	2009	2010	2011	2012	2013	2014
Smolts Counted	5618	7052	7490	7351	6909	7980	7123	6629	7717	6357	8150
Smolts Released		6967	7340	7138	6691	7749	6979	6390	7542	5960	7957

4.7 Wild Salmon Kelts

4.7.1 Census

Kelts migrate downstream after spawning. A total of 355 wild salmon kelts were recorded in the downstream traps between December 2013 and June 2014. The main downstream migration was recorded during March when 35.5% of the total migration was recorded (Table 4.11).

The overall survival of kelts from the spawning stock in 2014 was 51.4%.

Table 4-11: Numbers of wild salmon kelts counted in 2014.

Month	SLDT	MRDT	Total
December '13	17	1	18
January '14	61	21	82
February	84	15	99
March	123	3	126
April	18	6	24
May	5	0	5
June	1	0	1
	309	46	355

4.7.2 Tagging of wild kelts

Following the cessation of drift netting during 2007 and the corresponding increase in the wild spawning stock at Burrishoole tagging of the wild kelts recommenced during 2008. A total of 331floy tagged kelts were released from the downstream traps in 2014. During the summer of 2014 a total of 8 previously spawned grilse were recovered. The percentage recovery of PSGs for 2014 decreased from 4.5% in 2013 to 2.4 % in 2014 (Table 4.12).

Table 4-12: Comparison of annual salmon kelt runs.

Year	Kelt Quality Grade				
	A	B	C	D	E
1975-79	75	18	14	30	8.1
1980-84	82	18	6.7	48.7	9.7
1985-89	88	21	5.1	43.2	8.4
1990-94	92	31	4.8	61.4	6.6
1995	74	28	18.3	59.9	2.3
1996	88.1	27	10.1	53.1	4.0
1997	93.7	33.5	6.3	58.9	*
1998	94.3	30.8	5.7	67.6	*
1999	90.6	38.5	4.5	76	*
2000	92.5	44.5	5.5	62.1	*
2001	97	38.5	2.8	72.5	*
2002	91.3	40.9	7.8	49.6	*
2003	95.5	37	3.5	42.3	*
2004	89.9	36.3	9	53.2	*
2005	83.3	35.5	15.3	57.6	*
2006	82.2	36.1	16	54.4	*
2007	95	37.3	4.1	**	*
2008	93.2	26.9	6.8	**	5.6
2009	96.1	20.8	3.3	43.8	4.9
2010	98.1	13.5	1.3	34.2	10.1
2011	95.9	22.7	0.5	35.5	4.1
2012	96.7	20.8	2.8	54.7	3.6
2013	95.1	29.6	4.6	53.9	4.5
2014	91.3	40.7	6.7	51.4	2.4

* no kelt tagging

** see section 4.7 (2007 report)

A = % healthy kelts in kelt run

B = % males in kelt run

C = % lightly marked

D = % survival from wild spawning escapement

E = % recapture of previously spawned grilse in first year

5 Reared Salmon Census Programme

A programme of rearing and releasing tagged salmon has been carried out in Burrishoole since the early 1960s. The stock was based originally on donor wild salmon from the Burrishoole system and the stock has been closed since using returning tagged fish as broodstock. Additional experimental groups are sometimes released and these are freeze branded and differentially tagged so as to avoid mixing these with the core ranched stock. The ranched stock facilitates data collection and comparison with the wild stock without putting undue stress or mortality on the wild stock – in this report the ranched stock are known as reared grilse and reared 2SW salmon.

5.1 Coastal Returns

Details of coastal returns of Burrishoole fish are available in the Marine Institute 'National Report for Ireland - The 2014 Salmon Season' report.

5.2 Return rate of reared and wild grilse

A total of 1205 microtags were recovered from reared fish returning to Burrishoole in 2014. The average return rate of the fish identified as Burrishoole core grilse was 3.23%. For comparison, the return rate of ranched grilse in recent years was 2.9% in 2013 and 4.89% in 2012.

The percentage return of wild grilse in 2014 at 4.5% was much lower than in recent years. In 2013 the return rate was 9.4% and in 2012 was 10.5%.

5.3 Recapture of Reared 2SW Fish

The total number of microtagged 2SW reared fish recorded in Burrishoole during 2014 was 48 comprising of 7 core release groups.

5.4 Smolt Releases 2014

A total of 40,913 ranched smolts were released from Burrishoole during 2014. They consisted of seven individual microtag codes, six of which were released as part of the on-going core ranching programme and one experimental group which was branded with a T-brand. All of the smolts were released into Lough Furnace on 1st May. For additional information, see section 3.1.1.

Table 5-1: Details of microtag codes and smolt release groups 2014.

Group ID	Tag Code	Mean Wt	Mean Length	No. Released	Date released
Core	64783	58.60	17.0	7,215	01/05/2013
Core	64784	57.90	17.0	7,214	01/05/2013
Core	64785	56.90	17.0	7,397	01/05/2013
Core	64788	47.60	15.9	5,668	01/05/2013
Core	64787	46.00	15.8	4,108	01/05/2013
Core	64786	47.50	15.9	3,101	01/05/2013
Experimental	64789	64.80	17.6	6,210	01/05/2013

5.5 Reared kelts

In 2013 a total of 105 ranched fish were floy tagged swabbed and released upstream. Between June and December, 93 (88.6%) of the fish released up were recaptured in the downstream traps the majority of which were retained as broodstock in the Smolt Unit. In 2014 a further 10 ranched fish were recorded in the downstream traps. Therefore a total of 103 (98%) of the 105 fish released upstream in 2013 were accounted for in the downstream traps.

In 2014 a total of 117 ranched fish were released upstream during the summer. By the end of December 2014 a total of 97 fish (83%) were recaptured in the downstream traps of which 86 were transferred to the broodstock ponds.

In 2015, an additional 15 ranched grilse were recorded in the downstream traps. Therefore a total of 111 (95%) of the 117 fish released upstream in 2014 were accounted for in the downstream traps.

6 Wild Sea Trout Census Programme

6.1 Upstream Movements: Timing and Numbers.

A total of 142 wild silvered sea trout and a further 91 non-silvered trout migrated upstream through the traps in 2014. Of the silvered trout, 16 were adults and 126 (88.7%) were finnock. The numbers are compared with other years in Table 6.1. Of the total run of migratory (silvered and unsilvered) trout (233), 39.1% were unsilvered. For the purposes of this report, the unsilvered trout are not included with the sea trout. Table 6.1 shows that the numbers of sea trout have not recovered in the Burrishoole system and have shown a ten-fold drop since the 1970s.

Table 6-1: Annual runs of sea trout recorded in the traps.

Year	Mill Race	Salmon Leap	Total	Amended Total
1970-74	1365	762	2127	
1975-79	829	1775	2604	
1980-84	458	780	1238	1719 *
1985-89	386	590	978	
1990-94	134	72	206	
1995-99	86	91	177	
2000-04	32	64	97	
2005-09	21	44	65	
2000	33	78	111	
2001	31	58	89	
2002	26	89	115	
2003	45	33	78	
2004	26	64	90	
2005	5	10	15	
2006	16	22	38	
2007	35	59	94	
2008	4	36	40	
2009	45	93	138	
2010	10	62	72	
2011	15	53	68	
2012	19	120	139	
2013	20	50	70	
2014	16	126	142	

* See Table 34, Ann. Rep. XXX (1985); p. 43.

The timing of the sea trout run in 2014, and in previous years, expressed in monthly percentages, is given in Table 6.2. The highest proportion of sea trout, both finnock and adults, moved upstream in July with few fish after July. The unsilvered trout moved upstream in July and again in October.

Table 6-2: Timing of the Burrishoole (a) silvered sea trout run and (b) unsilvered trout run (in monthly percentages). (n = no. of trout).

(a) Silvered Trout

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04 (483)	2005-'09 (325)	2009 (138)	2010 (72)	2011 (68)	2012 (139)	2013 (70)	2014 (142)
May	-	0.2	0.5	0.1	3.1	2.0	1.3	0.0	0.0	13.2	1.4	1.4	0.0
June	13.1	24.6	9.4	8.4	8.6	16.7	9.0	2.2	0.0	0.0	11.5	4.3	14.8
July	54.4	44.9	62.2	55.0	42.4	37.5	32.5	88.4	85.9	16.2	60.4	30.0	77.5
Aug	15.8	10.3	18.4	16.5	19.3	26.4	38.1	6.5	8.5	35.3	18	44.3	5.6
Sept	7.6	14.8	3.7	8.5	9.8	5.7	13.6	0.7	5.6	22.1	5	5.7	0.7
Oct	6.4	3.5	4.1	7.9	12.2	10.2	4.7	2.2	0.0	7.4	2.9	12.9	1.4
Nov	2.4	1.5	1.5	2.9	4.3	1.5	0.7	0.0	0.0	5.9	0.7	1.4	0.0
Dec	0.3	0.2	0.2	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0

(b) Unsilvered Trout

	2005 (86)	2006 (61)	2007 (94)	2008 (76)	2009 (91)	2010 (104)	2011 (87)	2012 (47)	2013 (101)	2014 (91)
April	0	0	2.2	2.6	2.2	0.0	3.4	0	1.0	3.3
May	4.7	16.4	5.4	3.9	5.6	1.0	5.7	0	3.9	9.9
June	10.5	9.8	19.4	13.2	8.9	0.0	3.4	21.7	6.9	12.1
July	4.7	16.4	25.8	21.1	23.3	44.2	12.6	17.4	9.9	30.8
Aug	43	11.5	4.3	31.6	12.2	16.3	14.9	13.0	34.7	4.4
Sept	12.8	13.1	6.5	7.9	7.8	17.3	11.5	13.0	9.9	3.3
Oct	9.3	27.9	7.5	9.2	24.4	7.7	11.5	19.6	24.8	25.3
Nov	10.5	3.3	20.4	2.6	14.4	11.5	36.8	6.5	5.0	6.6
Dec	4.7	1.6	8.6	7.9	1.1	1.9	0.0	8.7	5.0	4.4

6.2 Spawning Escapement

With the continuation of the catch and release bye-law into the 2014 fishing season, no sea trout were reported killed by anglers on L. Feeagh in 2014. Using the upstream fish counts through the traps, the total maximum spawning escapement of migratory trout to the L. Feeagh catchment was 142, of which 91 were non-silvered sea trout.

Table 6-3: Annual spawning escapement of sea trout into freshwater, 1970-2014.

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04	2005-'09	2010	2011	2012	2013	2014
Max. Escap.	2090	1146	906	231	289	156	146	175	155	186	171	233
Revised	1622											

6.3 Downstream Movements, Sea Trout Smolts

The 2014 smolt run amounted to 427 smolts, all of which were released downstream (Table 6.4). Few smolts were recorded from January to March and even in April the number was low. The main migration occurred in May (85%) and was strongly regulated by both water level and water temperature (Fig. 6.1). The 2014 smolt count was low compared to the last few years (Table 6.5).

Table 6-4: Monthly numbers of Burrishoole sea trout smolts recorded through the traps.

Month	Salmon Leap	Mill Race	Total	%
January	0	0	0	0.0
February	2	0	2	0.5
March	6	0	6	1.4
April	52	2	54	12.6
May	336	27	363	85.0
June	2	0	2	0.5
July	0	0	0	0.0
Total	398	29	427	
Number Released Downstream			427	

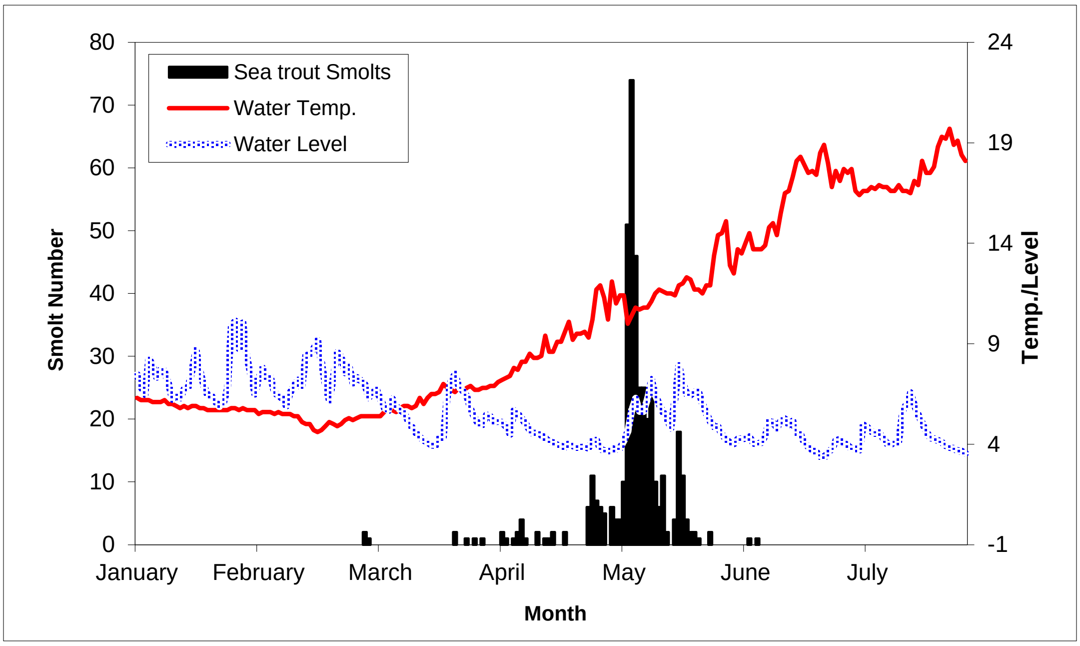


Figure 6-1: Timing of the 2014 wild sea trout smolt migration with daily midnight water level (m x 10) and midnight temperature (^{0}C).

Table 6-5: Annual sea trout smolt numbers in Burrishoole for 1970 to 2014.

	1970-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	2010	2011	2012	2013	2014
Number of Smolt	4176	4038	4119	1531	1361	816	609	213	620	632	485	427

A total of 333 wild smolts were measured in 2014. Length measurements were taken to facilitate an estimated age breakdown of the smolt run. The estimated statistics for the 2014 smolts were a mean length of 19.6 cm and a range from 14.2 to 26.0 cm and the length frequency is presented in Figure 6.2 compared with that of 2012 and 2013. This gave an estimated age of 81.8% 2 year old and 18.2% 3 year olds.

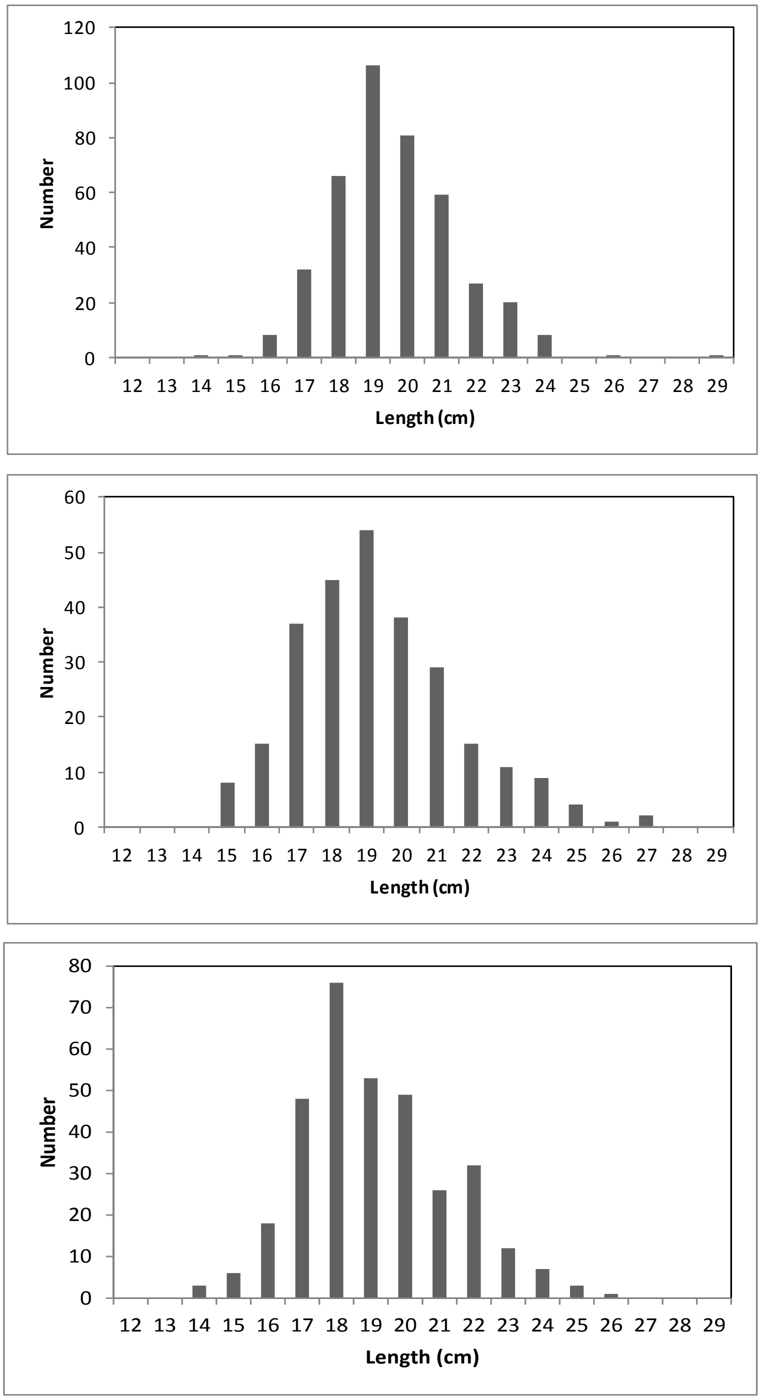


Figure 6-2: Length distributions for smolts in the Burrishoole system, top graph 2012 (n=411), middle graph 2013 (n=268) and bottom graph 2014 (n=333).

6.4 Autumn Migrating Smolts

These are juvenile trout (*Salmo trutta* L.) which generally move downstream through the traps from August to December. It is not clear whether these are true sea trout or part of the resident trout stock being displaced downstream. It is known through mark-recapture studies that a proportion of the 1+ autumn trout do return the following year as silvered finnock. These runs of trout would appear to becoming more prolonged with substantial numbers of un-silvered 0+ and 1+ trout continuing to migrate downstream in the early months of the year.

A total of 759 trout entered the downstream traps between July 2014 and May 2015 (Table 6.6). The percentage of 0+ trout that migrated over the period was 36.6% (Table 6.7).

Table 6-6: Numbers of migrating autumn juvenile trout in 2014, to the end of May 2015.

	0+		1+		Total	
Month	Salmon Leap	Mill Race	Salmon Leap	Mill Race	Salmon Leap	Mill Race
July	0	0	2	0	2	0
August	10	0	11	0	21	0
September	11	0	12	0	23	0
October	102	5	159	8	261	13
November	69	2	144	5	213	7
December	33	2	73	9	106	11
January '15	18	0	28	2	46	2
February '15	13	0	5	0	18	0
March '15	8	0	2	0	10	0
April '15	4	0	18	0	22	0
May '15	0	1	2	1	2	2
Total	268	10	456	25	724	35
Overall Total	278		481		759	

Table 6-7: Percentage of 0+ juvenile trout (<10cm) in the trapped autumn migrating trout.

Year	% 0+	Year	% 0+
1982	50.0	1999	42.0
1983	N/A	2000	47.8
1984	55.8	2001	56.3
1985	30.3	2002	32.8
1986	16.1	2003	48.9
1987	35.3	2004	35.5
1988	60.9	2005	37.3
1989	37.2	2006	51.2
1990	35.2	2007	27.9
1991	26.0	2008	28.2
1992	38.2	2009	25.0
1993	27.6	2010	34.9
1994	16.8	2011	37.6
1995	25.3	2012	47.3
1996	34.0	2013	36.1
1997	18.7	2014	36.6
1998	33.5		

6.5 Total Recruitment

The 0+ autumn trout will not be large enough to become sea trout smolts in the following spring. The remainder, predominantly 1+ year olds, could contribute to the overall recruitment of sea-run trout the following year. The exact proportion of 1+ autumn trout that become smolts in any given year is not known. It is only since 1982 that the proportion of 0+ trout amongst the autumn migration has been estimated. Thus the figures for total recruitment up to this time are over-estimated (Table 6.8).

From 1982, total recruitment was calculated by adding the number of sea trout smolts produced in any one year to the total of 1+ autumn trout the previous year (Table 6.9). The assumption is made that all the 1+ autumn trout will become sea trout smolts and that no 0+ trout from the two years previous will be recruited as smolts. The fate of 1+ unsilvered juveniles migrating down in January to May is unknown but seems unlikely these will contribute to the 2+ spring smolt migration.

Table 6-8: Estimates of total migrant trout recruitment up to 1981.

Year	Smolt Total	Autumn trout (preceding year)	Total Recruitment
1970-74	4450	2870	6746
1975-79	4314	3186	7489
1980	2337	2351	4688
1981	6710	2631	9341

Table 6-9: Estimates of total migrant trout recruitment from 1982 to date.

Year	Smolt Total	1+ Autumn trout (preceding year)	Total Recruitment
1982-84	3714	1203	4917
1985-89	3706	1063	4778
1990-94	1788	399	2187
1995-99	1361	498	1860
2000-04	816	578	1377
2000	769	358	1127
2001	530	218	748
2002	1272	910	2100
2003	787	976	1763
2004	723	426	1149
2005	777	590	1367
2006	628	251	879
2007	593	377	970
2008	393	534	927
2009	657	495	1152
2010	213	267	480
2011	620	501	1121
2012	632	493	1125
2013	485	536	1021
2014	427	351	778

6.6 Marine Survival

An estimate of sea trout survival to first return to freshwater can be more accurately calculated by the use of trap census data rather than rod catch returns of tagged or marked fish. Small numbers of stray fish are captured in other systems and it is not known whether these fish would have returned to their natal systems to spawn. Finnock are known to wander between river systems and are therefore not as reliable for assessing survival.

The pattern of marine survival found is similar whether the number of smolts is used or the combined total recruitment of smolts and autumn 1+ trout. The percentage of smolts that return as finnock (0+ sea age) in the same year historically ranged from 11.4% to 32.4% (Fig. 6.3). In 1988 it fell below the previous recorded minimum to 8.5% and in 1989 to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's rising to 16.7% in 1999, 18.1% in 2009 and 17.5% in 2010 – the highest return rates since 1986. These increases were not, however, always sustained in subsequent years and there was a collapse in 2005 down to 1.5%. This was associated with the heaviest infestations of sea lice observed in the Burrishoole area since 1992. The return of smolt as finnock in 2011 was 5.8%, 13.8% in 2012, 11.0% in 2013 and 29.5% in 2014 – the highest recorded level since the mid-1970s.

The total survival of smolts to their first return to freshwater as finnock in the same year and one year old sea trout in the following year (always an over-estimate as a proportion of finnock re-entering freshwater in year 1 return as sea trout in year 2 (Mills *et al*, 1990)) also showed a drop in survival from 1987 to 1989 (Fig. 6.4).

Historically, the total survival to first return ranged from 19% to 66%. This collapsed to 1.8% in 1989 but rose to 12.1% in 1990. However, little further improvement was recorded in 1991 (12.8%). Marine survival fell to the second lowest level in 1992 but returned to 13.2% for the 1993 year class of smolts. There was a further increase in 1994 to 17.0% but a drop in 1995 to 8.4%. There were marginal improvements again in 1996 (12.8%) and 1997 (13.1%), a drop to 8.3% in the 1998 year class and a marked improvement in the 1999 year class where marine survival was 20%, the highest recorded in 12 years and back within the pre-collapse historical range. Total survival increased for the 2009 cohort to the highest recorded level since 1988 of 23% and to 23.2% for the 2010 cohort. For the 2011 cohort of smolts, it was 10.2% and for the 2012 cohort it was 17.1%. In 2013 it was 14.4%.

NOTE: The data used in Chapter 6.6 have been updated in 2014 following a comprehensive data quality control project. None of the changes were significant and the main changes were in 2011 and 2012 following a reclassification of trout considered to be silvered and unsilvered.

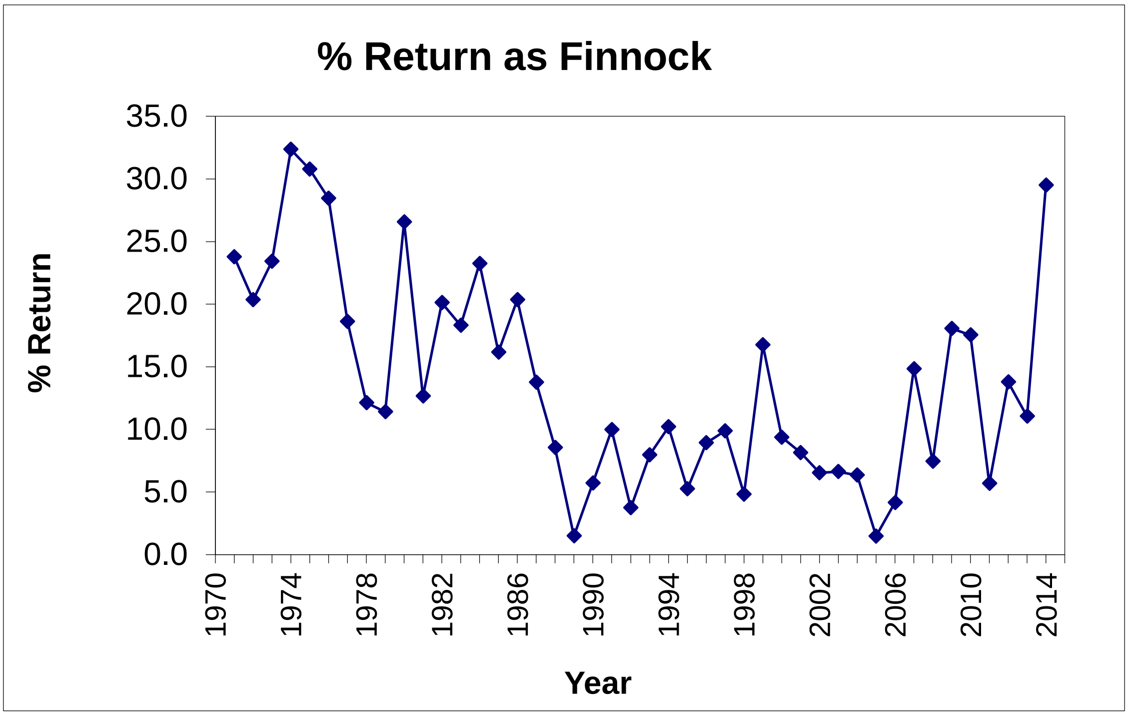


Figure 6-3: Annual percentage return of smolts returning as finnock to the Burrishoole system.

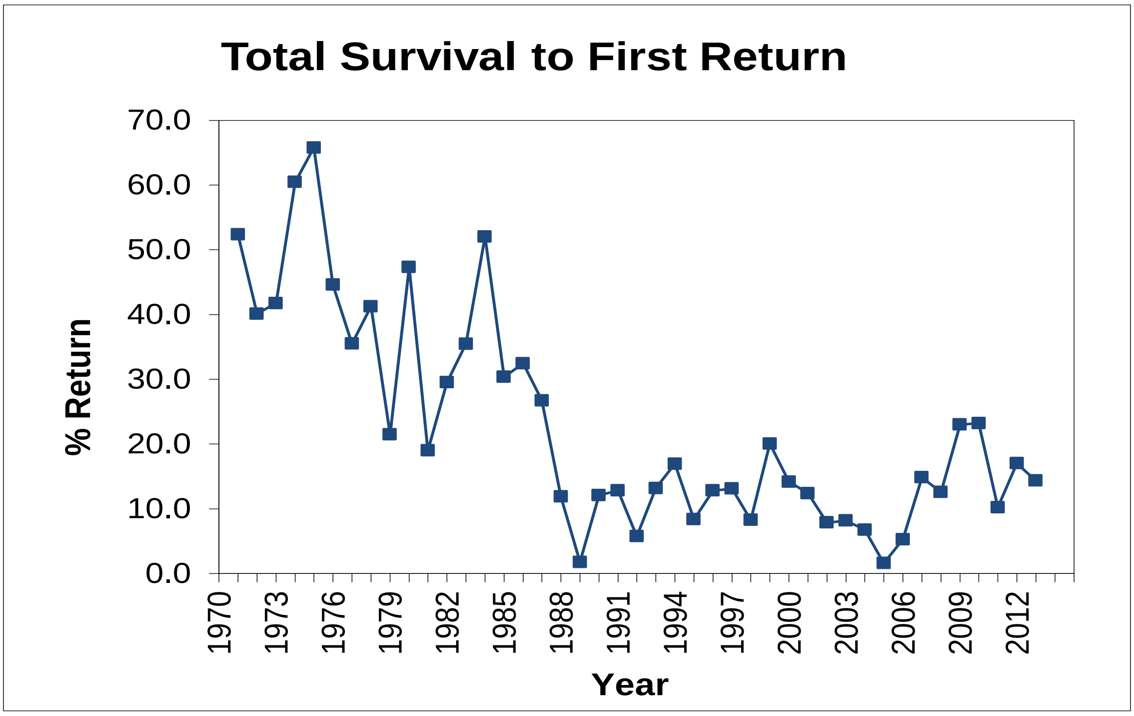


Figure 6-4: Annual marine survival of smolts to first return (as finnock and 1+ sea trout) to the Burrishoole system.

6.7 Sea Trout Kelts

Table 6.10 gives the numbers of sea trout and brown trout kelts, both spawned and immature, counted downstream in the winter of 2013 and spring of 2014.

The freshwater survival of kelts is given in Table 6.11. In some years, the number of kelts migrating downstream has exceeded the number of upstream migrants. This occurred in the early '80s when the screen allowed finnock to escape. This was rectified. More recently, the difficulty in separating small finnock and large smolts has led once again to a discrepancy as shown in Table 6.11. In addition to the size overlap, trout counted upstream as unsilvered migrants may be counted downstream as silvered kelts, and immature autumn downstream migrants may be misidentified as brown trout kelts, both causing additional difficulties in making survival estimates.

Since 1987, only one survival rate has been given for all sizes as it has been shown that a proportion (at least 33%) of the sea trout population may over-winter in freshwater. These fish do not spawn and continue to grow. There is also the additional complication of larger smolts and reduced sea growth mentioned above. Thus the comparisons of the proportion of fish in different year classes between the upstream migrants of one year and the downstream migrants of the next are invalidated.

In 2013/14, overall sea trout kelt survival was 87.1% and for finnock only (small sea trout) it was 88%.

Table 6-10: Timing and numbers of sea trout kelts for the 2013/2014 season.

Month	Large ST	Small ST	BT	Total ST	Total Trout
October '13	0	0	6	0	6
November	1	8	8	9	17
December	5	11	45	16	61
January '14	5	4	19	9	28
February	0	3	12	3	15
March	1	11	14	12	26
April	5	5	4	10	14
May	0	2	4	2	6
June	0	0	1	0	1
Total	17	44	113	61	174

Table 6-11: Annual survival rate to sea trout kelt, as % of the upstream escapement of the previous year.

Year	Larger (> 30.0 cm)	Small (< 30.0 cm)	Year	Larger (> 30.0 cm)	Small (< 30.0 cm)
1976	79	66	1996	127.70%	" *
1977	63	45	1997	97.00%	" *
1978	50	66	1998	140.10%	" *
1979	33	107*	1999	110.40%	" *
1980	50	82	2000	70.10%	"
1981	44	345*	2001	82.00%	" *
1982	53	203*	2002	129.60%	" *
1983	63	177*	2003	66.10%	"
1984	74	210*	2004	120.50%	"*
1985	70	98	2005	142.20%	"*
1986	66	72	2006	110.50%	"
1987	58.70%	(combined)	2007	228.90%	"**
1988	65.50%	"	2008	98.90%	"**
1989	68.70%	"	2009	107.50%	"*
1990	79.00%	" *	2010	59.40%	"
1991	98.70%	" *	2011	88.90%	"*
1992	89.50%	" *	2012	117.65%	"*
1993	96.70%	" *	2013	161.33%	"*
1994	104.60%	" *	2014	87.14%	"
1995	96.20%	“ *			

* Years when the number of finnock kelts counted downstream exceeded the number counted upstream during the previous season.

7 Silver Eel Census Programme

7.1 Numbers

Silver eel trapping was continued in 2014. The main run (71%) occurred in October (Table 7.1). Figure 7.1 shows the daily counts of silver eels. Note Table 7.1 has been reconfigured with the silver eel year going from May to April.

The total run amounted to 3122 eels. As in other years, the highest proportion of the total catch (85%) was made in the Salmon Leap trap.

There was considerable influence on the run timing due to low water levels in August and September with a large peak on one night in October.

Table 7-1: Timing and numbers of the 2014/'15 silver eel run.

	Salmon Leap	Mill Race	Total	%
May	4	1	5	0.2
June	0	0	0	0.0
July	51	6	57	1.8
August	393	74	467	15.0
September	100	14	114	3.7
October	1854	349	2203	70.6
November	127	9	136	4.4
December	122	15	137	4.4
Jan. 2015	3	0	3	0.1
February	0	0	0	0.0
March	0	0	0	0.0
April	0	0	0	0.0
Total	2654	468	3122	

7.2 Size

Sampling of individual eels (n = 651) gave an average length of 45.0cm (range: 29.2 – 101.5cm) and an average weight of 195.7g (Table 7.2). The length frequency distribution is presented in Figure 7.2 along with those for 2012 and 2013 for comparison.

Counts of silver eel between the years 1971 (when records began) and 1982 averaged 4,400, fell to 2,200 between 1983 and 1989 and increased again to above 3,000 in the '90s (Fig. 7.3). There was an above average count in 1995, possibly contributed to by the exceptionally warm summer. The count in 2001 of 3875 eel was the second highest recorded since 1982. The average weight of the eels in the samples has been steadily increasing from 95 g in the early 1970s to 216 g in both the 1990s and the 2000s (Fig. 7.3). The annual count and average weight in 2010 and 2011 were both below the mean for the last decade.

In 2012, the majority of the eel run was sampled (n=3317; 99.5%). The run increased from 1969 in 2011 to 3335 in 2012 and the average weight decreased from 180 to 163.5g. The sex ratio changed from 24% to 45% over the past five years. Male eels have remained the same length over the past 15 years (36cm) whereas the females have changed from 53cm (1997-2005) to 50cm (2008-2012) and they were 49.2cm in 2012.

In 2014, the migration was 3114 eels and 651 were sampled. The mean weight was 195.7g and the proportion of male eels was 32.2%, lower than the previous three years and similar to the average for the past decade (34.5%).

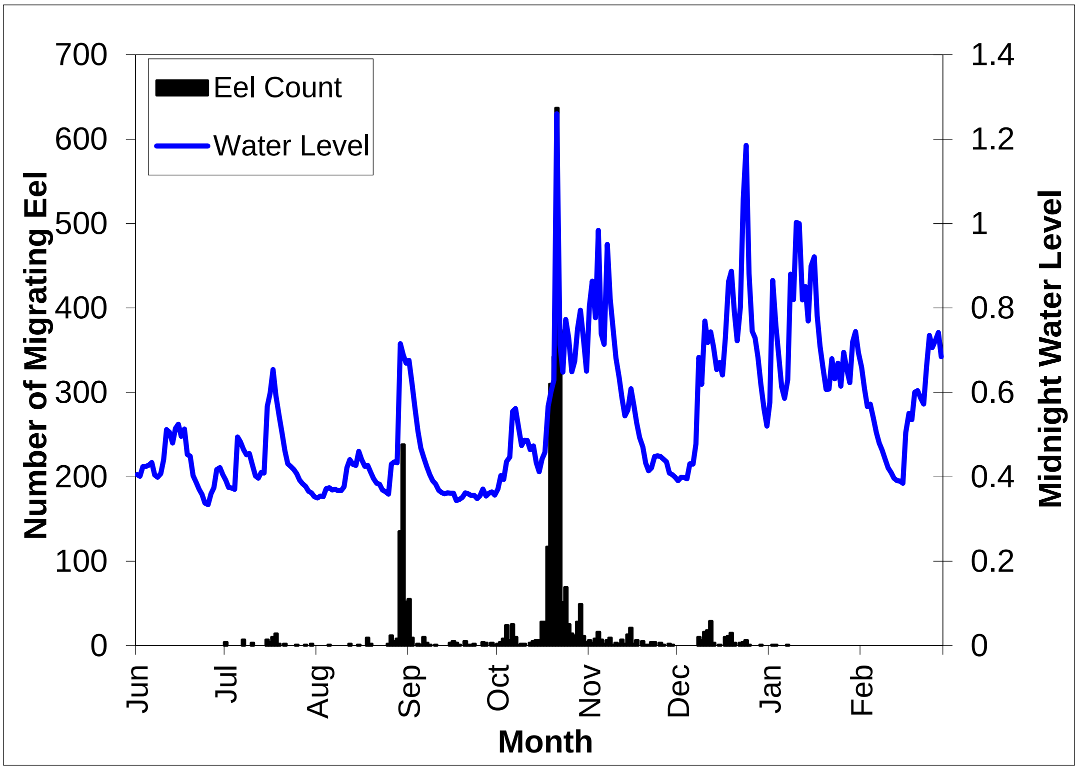


Figure 7-1: Daily counts of downstream migrating silver eel and mid-night water levels (m).

Table 7-2: Comparative data for the silver eel runs since 1971.

Years	Number Sampled	Mean. Weight (gm)
1971 - '75	4465	84
1976 - '80	4023	115
1981 - '85	2678	171
1986 - '90	11658	196
1991 - '95	3441	227
1996 - '00	3958	212
2001	850	238
2002	732	207
2003	650	177
2004	382	216
2005	587	237
2006	493	225
2007	571	201
2008	796	234
2009	220	209
2010	982	192
2011	1835	180
2012	3315	163
2013	1301	157
2014	650	196

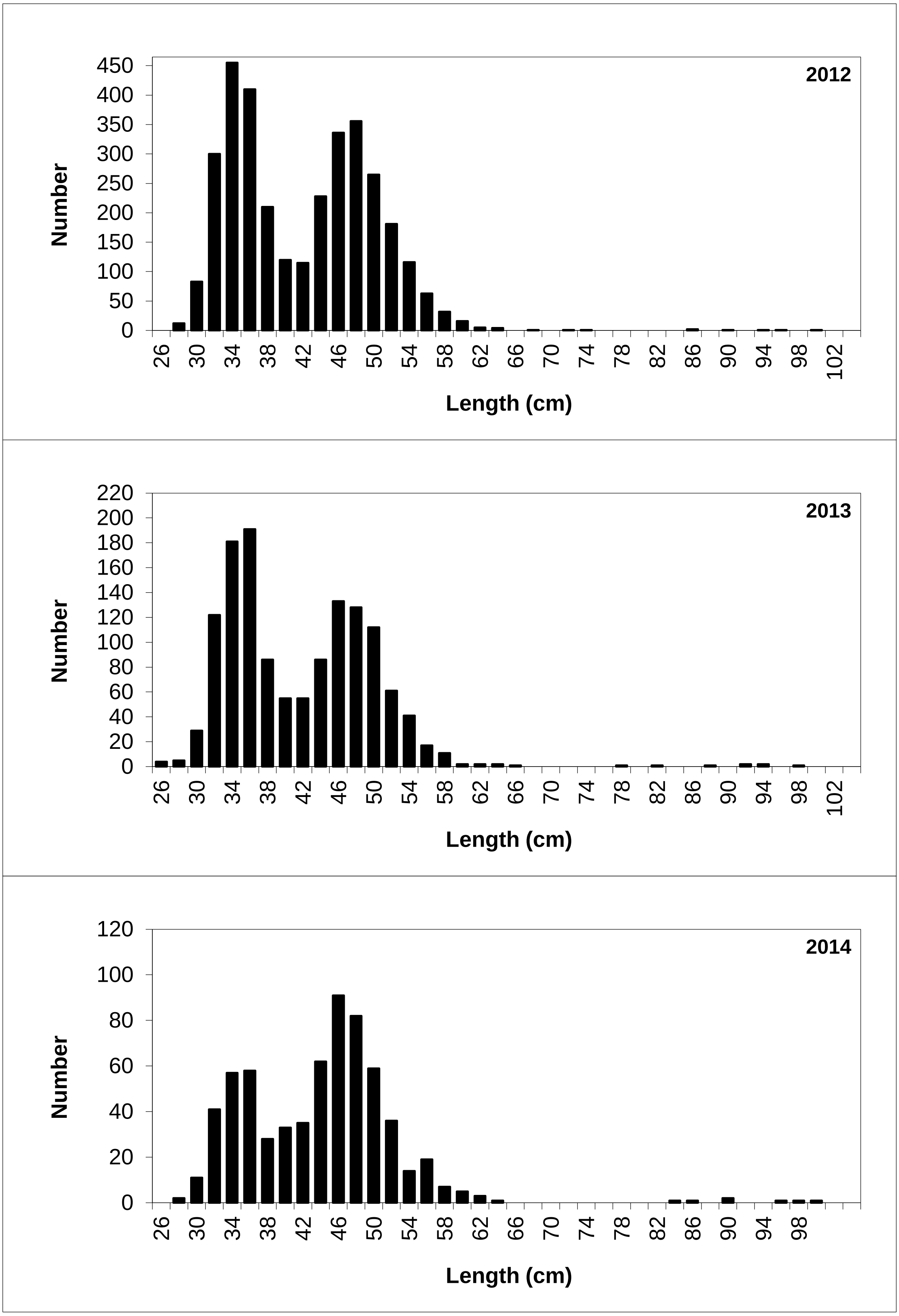


Figure 7-2: Length frequency of sub-samples of silver eels trapped in the downstream traps, 2012 (n=3317), 2013 (n=1329) and 2014 (n=650). Note change of y-axis scales.

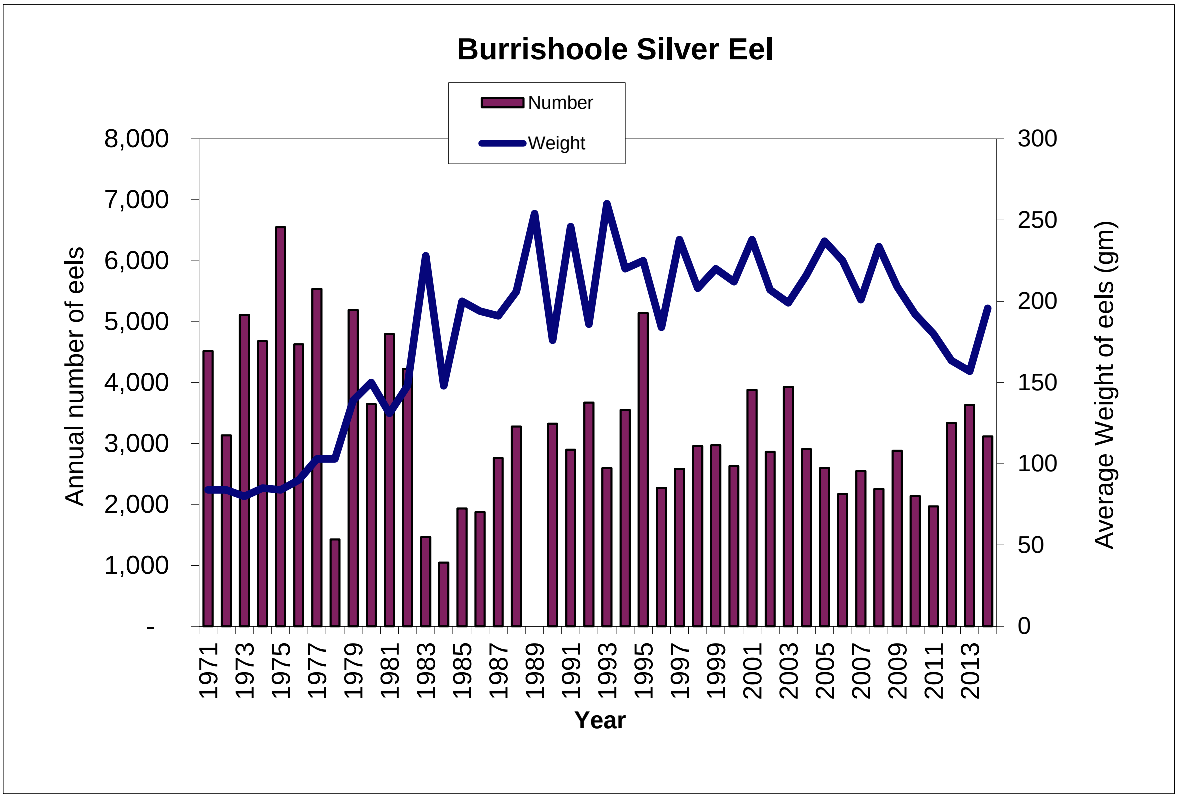


Figure 7-3: Annual number and mean weight of silver eels trapped in the downstream traps.

8 Fishery Report – Catch Data

The Burrishoole Fishery is a valuable part of the overall stock census programme and is run as an integral part of the monitoring programme. As part of the conservation of the Burrishoole wild stock, changes to the active season and to the parts of the catchment being fished have caused differences, or gaps, in the data being collected. Lough Feeagh, which had been closed to angling since 1997 for conservation reasons was opened to angling for the month of September in 2008, on a catch and release basis for wild fish. In 2009 - 2013 Lough Feeagh was open for angling on a catch and release basis from August to the end of September. In 2014 Lough Feeagh was opened to angling on the 24th August for one week only due to low stock.

During 2014 Lough Furnace was open to angling from 18th of June to the 30th September. The fishery was operated on a 5 day week from Wednesday to Sunday inclusive and on a catch and release basis for wild fish.

8.1 Numbers and Average weight of Rod Catch

The Lough Furnace rod catch in 2014 consisted of 8 wild fish and 40 reared fish. All wild caught fish were returned alive. No wild or reared fish were caught on Lough Feeagh.

The average weight of reared fish was 1.8kg (n = 40) and the heaviest fish was 2.8kg. No lengths or weights are available for wild fish due to catch & release being in place.

A total of 53 sea trout were caught on Lough Furnace and 19 sea trout on Lough Feeagh. Regulations remained in place whereby all rod caught sea trout were returned alive.

In addition to the sea trout caught on Lough Feeagh, a total of 71 brown trout were also caught on the lough.

8.2 Timing of Catch and Rod Effort

The highest monthly salmon catch was recorded in August with a catch of 7 wild and 25 ranched salmon. August was also the month of the highest rod effort and overall the rod effort on Lough Furnace increased from 134 rod days in 2013 to 152 rod days in 2014.

The total catch on Lough Furnace of 8 wild salmon is a reflection of the poor return of wild fish to the Burrishoole system during 2014.

As a consequence of the poor wild return Lough Feeagh was only opened to angling for just over a week with 2 anglers fishing half days. During this period no salmon were caught, the catch consisted of 19 seatrout and 71 brown trout.

Table 8-1: Wild and reared salmon rod catch and rod effort (hours) for the 2014 season for L. Furnace and L. Feeagh.

Furnace

	Salmon Catch		Effort in hours
	Wild	Reared	
May	0	0	0
June	0	1	56
July	1	14	535.5
August	7	25	583
September	0	0	39
Total	8	40	1213.5

Feeagh

	Salmon Catch		Effort in hours
	Wild	Reared	
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	27
September	0	0	0
Total	0	0	27

8.3 Exploitation Rates of Rod Fishery

Rod exploitation rates for Lough Furnace and Lough Feeagh from 2003 to 2011 are shown in Table 8.2. From 1997 onwards Lough Feeagh was closed to angling. Exploitation rates are only available for Lough Furnace since 1997. The cessation of angling on Lough Feeagh was due to the continuing low stock level of wild fish. Following the cessation of drift netting in 2007 and the increased return of wild fish it was decided to re-open Lough Feeagh in 2008 to angling for the month of September only on a catch and release basis for both wild and ranched fish. Since 2008, and in future years, the running of a fishery on L. Feeagh was reviewed each year and was dependent on sufficient wild stock being present.

No sea trout angling has been permitted on L. Feeagh since 1997 and any fish captured are returned alive.

Anglers fishing on Lough Furnace were requested to return wild fish alive to the water. Injured or damaged wild fish were permitted to be retained; therefore, the rod catch on Lough Furnace consists of a total catch which includes released fish and a retained catch which are fish that have been killed.

Rod exploitation rates for Lough Furnace and Lough Feeagh from 2004 to 2013 are shown in Table 8.2.

Table 8-2: Rod fishing exploitation rates (2006-2014).

	2006	2007	2008	2009	2010	2011	2012	2013	2014
WILD SALMON									
Lough Feeagh									
"Available" fish by end of fishing season	*	*	531	585	691	516	683	694	145
Total rod catch			18	5	8	13	28	16	0
Rod catch retained			0	0	0	0	0	0	0
Angling success %[1]			3	0.85	1.15	2.5	4.10	2.31	0.00
Exploitation rate %[2]			0	0	0	0	0	0	0
WILD SALMON	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Loughs Feeagh & Furnace									
Total stock of wild fish	566	1063	572	587	703	571	686	734	305
+ 10% addition for L. Furnace population	623	1169	629	646	773	628	755	807	336
Total catch of wild fish	48	26	52	12	26	36	50	35	8
Rod catch retained	5	2	1	1	0	0	0	1	0
Max. angling success %	8.5	2.4	9.1	2	3.7	6.3	7.3	4.8	2.6
Min. exploitation rate	0.9	0.2	0.2	0.2	0	0	0	0.1	0
Max. exploitation rate	0.8	0.2	0.2	0.2	0	0	0	0.1	0
REARED SALMON	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Lough Feeagh									
"Available" fish by end of fishing season	*	*	98	115	130	125	128	105	117
Total rod catch			1	1	1	1	3	1	0
Rod catch retained			0	0	0	0	0	0	0
Angling success %[1]			1.0	0.9	0.8	0.8	1.5	1.0	0.0
Exploitation rate %[2]			0.0	0	0	0	0	0	0
Loughs Feeagh & Furnace									
Total stock	954	2624	1865	456	940	1293	2392	1301	1205
Total rod catch	66	169	116	7	79	86	78	71	40
Exploitation rate %	6.9	6.4	6.2	1.7	8.4	6.7	3.3	5.5	3.3
WILD SEA TROUT	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Lough Feeagh									
"Available" fish by end of fishing season	*	*	39	135	71	58	129	60	140
Rod catch			3	12	1	1	5	12	19
Exploitation rate %			0	0	0	0	0	0	0
Angling Success %			7.7	8.9	1.4	1.7	3.9	20.0	13.6

8.4 Angling Success

Table 8.3 presents the Catch per unit effort (CPUE) which is the number of fish caught per rod day, and the Effort per unit catch (EUPC) which is the number of rod days it takes to catch a fish.

Table 8-3: Catch per unit effort (CPUE) and effort per unit catch (EPUC) for the Burrishoole Fishery based on a eight hour fishing day. Salmon includes both wild and reared.

	Lough Furnace				Lough Feeagh			
	Salmon		Sea Trout		Salmon		Sea Trout	
Year	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC
'80-'84	0.13	9.92	0.85	1.35	0.23	4.47	0.63	2.10
'85-'89	0.24	4.89	0.46	5.09	0.24	4.57	0.29	70.30
'90-'95	0.20	6.10	0.17	16.80	0.20	5.40	0.10	14.00
'96	0.22	4.40	0.10	10.50	0.83	1.20	0.30	2.90
'97	0.17	6.00	0.10	9.60	*	*	*	*
'98	0.44	2.30	0.08	13.20	*	*	*	*
'99	0.09	10.80	0.05	20.80	*	*	*	*
'00	0.30	3.31	0.06	16.50	*	*	*	*
‘01	0.15	6.70	0.12	8.40	*	*	*	*
’02	0.12	8.30	0.07	15.30	*	*	*	*
’03	0.13	7.60	0.06	17.70	*	*	*	*
’04	0.22	4.60	0.16	6.30	*	*	*	*
’05	0.26	3.80	0.08	13.00	*	*	*	*
’06	0.44	2.30	0.04	23.50	*	*	*	*
’07	0.49	2.10	0.14	6.90	*	*	*	*
’08	0.35	2.89	0.05	21.60	0.46	2.18	0.07	13.80
’09	0.18	5.66	0.24	4.09	0.21	4.75	0.42	2.38
’10	0.60	1.66	0.14	7.27	0.82	1.22	0.09	11.00
'11	0.68	1.47	0.35	2.8	1.06	0.95	0.08	13.1
’12	0.96	1.04	0.1	10.1	1.1	0.91	0.18	56.62
'13	0.66	1.51	0.22	4.5	0.6	1.7	0.42	2.4
’14	0.32	3.17	0.35	2.9	0	0	5.6	0.18

9 Collaborative Research Programmes

9.1 Beaufort Fish Population Genetics

See 2013 Annual Report for Information on these projects.

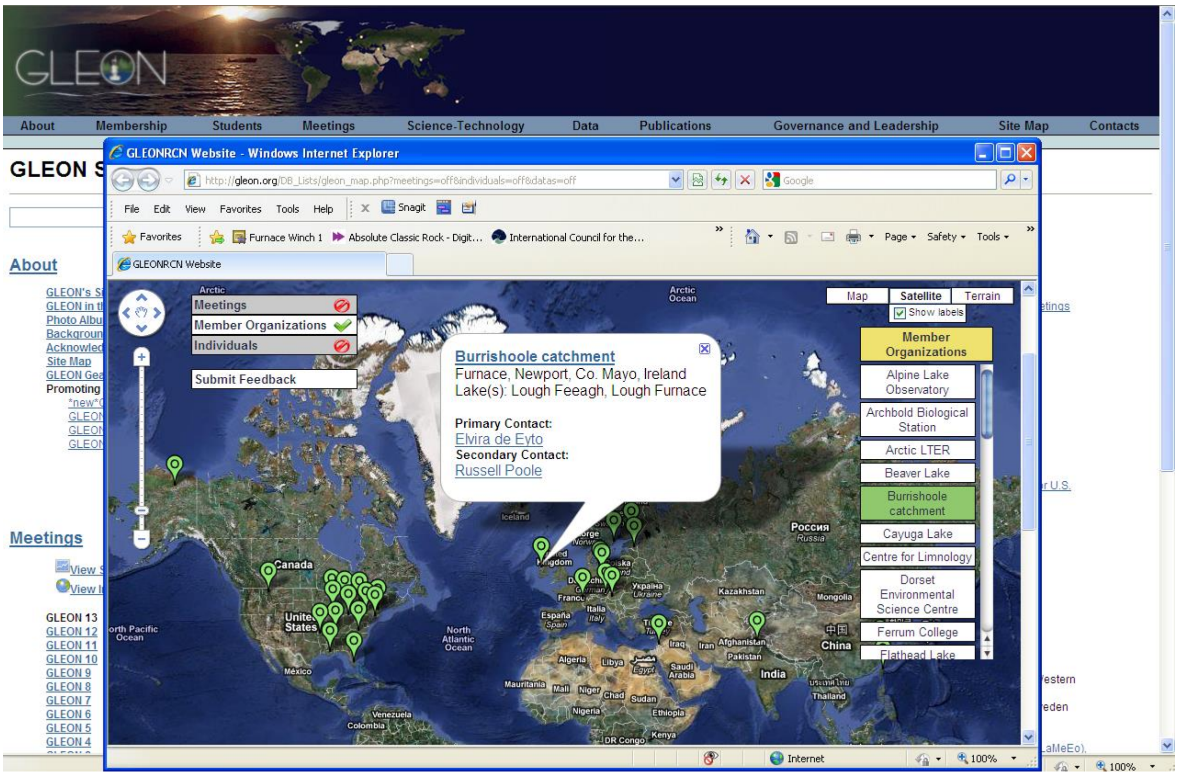
9.2 Lakes Studies

Estimating carbon pools and processing in a humic Irish lake.

Elizabeth Ryder successfully defended her PhD thesis **"Estimating carbon pools and processing in a humic Irish lake"** in August 2014, submitting a final corrected version in early 2015.

9.3 GLEON

In 2007, the Burrishoole catchment became a member of the Global Lake Ecological Observatory Network (GLEON: http://www.gleon.org), an association of limnologists, information technology experts and engineers whose goal is to establish a persistent network of lake ecology observatories (http://www.gleon.org). Work with GLEON working groups continued in 2014, and the Marine Institute was represented at GLEON 16 in Canada by Elvira de Eyto. Data from Lough Feeagh is being used in several GLEON working groups, including those focussed on signal processing of high frequency lake data, analysis of the effect of disturbance on phytoplankton, and the role of catchment processes and dynamics on lake metabolism.



9.4 NETLAKE

The Cost-ACTION NETLAKE project continued work in 2014 (www.dkit.ie/netlake). Cost action projects are funded by the EU to provide networking opportunities for scientists in specific research areas. The aim of the NETLAKE action is to build a network of sites and individuals that will support the use of sensor-based systems in lakes and reservoirs and promote the use of these systems to address current and future water quality issues. The Marine Institute (represented by Elvira de Eyto and Russell Poole) are on the management committee of NETLAKE. In 2014, meetings were held in Girona in January and in Uppsala in June. Active areas of work included the continued development of a metadatabase to capture the network of sites in Europe with automatic lake monitors, and production of a set of factsheets detailing high frequency monitoring system deployments. In addition, the MI co-hosted two STSMs (short term scientific missions) funded through NETLAKE. In September, Jonna Kuha from Finland spent some time deploying various CDOM sensors in Feeagh, for a comparative study, while at the same time, working on the analysis of EEMs (excitation-emission matrices) with Liz Ryder and Eleanor Jennings (DkIT). Between September and December, Dr. Biel Obrador (University of Barcelona) worked on data collected by the AWQMS on Lough Furnace, with the aim of assessing the relative importance of freshwater and marine influences on epilimnetic metabolism.

9.5 Other

A detailed reconstruction of land use and climate changes in Burrishoole were published in 2014 (Dalton et al. 2014). This work was the culmination of the ILLUMINATE project, and provides a crucial background in assessing non-stationarity in Burrishoole – relevant to determining stock-recruitment relationships for salmon and sea trout.

Work continued in 2014 within the GLTC (Global Lake Temperature Collaboration - www.**laketemperature**.org) to synthesise and analysis lake temperature data from around the world (including from Lough Feeagh).

During 2014, the catchment team began collecting samples for inclusion in the GNIR (Global Network of Isotopes in Rivers - http://www-naweb.iaea.org/napc/ih/IHS_resources_gnir.html). GNIR is a global environmental observation programme dedicated to the compilation of isotopic assays of water, nutrients and particulate and dissolved constituents in global river systems. GNIR serves as an essential world-wide repository for riverine isotope data, and facilitates public dissemination of contributed riverine isotopic data through a cost-free user-friendly web portal. GNIR is a complimentary programme to the IAEA (International Atomic Energy Agency) well-established Global Network of Isotopes in Precipitation. Monthly samples are taken from the Black and Mill Race rivers, and dispatched to the IAEA facility in Vienna for analysis.

10 Catchment Stock Assessment

10.1 Introduction

The Burrishoole catchment, upstream of the main fish traps, has been monitored since 1990 with surveys of the salmonid and eels stocks taking place in the rivers and the main lakes. Electrofishing, with 3-fishing depletions, is used for salmonids and eels in the streams, fine mesh beach seines are used for salmonids in the lakes and summer fyke nets are used for eels in the lakes. Eel surveys are also undertaken in the tidal waters below the traps.

10.2 Electrofishing Surveys

2014 marked the completion of 24 years of electrofishing surveys in the Burrishoole and Owengarve catchments. Densities of eels and juvenile salmonids were calculated using three pass removal sampling.

In 2014, 42 sites in the Burrishoole and Owengarve catchments were fished between the 7th August and the 10th September. 4228 fish were caught and measured over the 43 sites. The 42 sites comprised 6176m^2 of representative habitat. Summary data are presented in Figures 10.1-10.6, and these show the distribution of fish densities around the catchment for eel (Fig. 10.1), 0+ salmon (Fig. 10.2), 1+ salmon (Fig. 10.3), 0+ trout (Fig. 10.4), 1+ trout (Fig. 10.5) and 2+ trout (Fig. 10.6).

The average eel density was 0.010 fish/m^2, with eels recorded in 18 sites out of 42. High densities were recorded in the Owengarve and Goulaun Rivers.

Average density of 0+ salmon was 0.38 fish/m^2, with catches recorded in 31 sites. Highest densities were recorded in the Goulaun, Lodge and Rough Rivers, where densities exceeded 1 fish/m^2. The highest density recorded was 2.2 fish/m^2 which occurred at Rough Site 11 (below the junction with the Lodge River).

1+ salmon were recorded in 30 sites, with an average density of 0.07 fish/m^2. The Goulaun River generally had high densities of 1+ salmon.

Average densities of 0+, 1+ and 2+ trout were 0.24, 0.11 and 0.01 fish/m^2 respectively. 0+ and 1+ trout were recorded in 40 sites, while 2+ trout were recorded in 25 sites respectively.

Eel and trout numbers were a little lower than those recorded in 2013, while salmon numbers were slightly higher (Fig. 10.7).

10.3 Beach Seine Surveys

Beach seine surveys were conducted in 2014. The data were included in the survey database for future analysis.

10.4 Fyke Net Surveys

10.4.1 Survey Data

Fyke net surveys of yellow eels have been conducted in the 1970s and 1980s as parts of previous studies. The Burrishoole lakes Feeagh and Bunaveela have been incorporated into the National Eel Survey in 2009-2012. Fyke net surveys of the tidal Lough Furnace and 'Back of the House' have been more sporadic or at a lower effort.

Yellow-eel stock monitoring is integral to gaining an understanding of the current status of local stocks and for informing models of escapement. Such monitoring also provides a means of evaluating post-management changes and forecasting the effects of these changes on silver eel escapement. The monitoring strategy aims to determine, at a local scale, an estimate of relative stock density, the stock's length, age and sex profiles, and the proportion of each length class that migrate as silvers each year.

Fyke net surveys carried out between 1960 and 2008 will provide a useful bench mark against which to assess the changes in stock. The yellow eel monitoring strategy will rely on the use of standard fyke nets. Relative density will be established based on catch per unit (scientific-survey) effort.

Bunaveela Lough is located in the upper reaches of the catchment. It has a surface area of 42ha and a maximum depth of 23m. Bunaveela L. was fished in the traditional style (sets of 10 nets perpendicular to the shore) in 2014 (3 July 2014), with chains of 10 nets fished at three sites (A, B, C). In total 11 eels were caught with a catch per unit of effort of 0.37 eels/net/night (Table 10.1). The average length was 47.3cm and ranged in length from 35.7cm to 61.1cm. No eels were PIT tagged.

Lough Feeagh has a surface area of 395ha and an average depth of 14.5m (with several areas >35m in depth). L. Feeagh was fished in the traditional style (sets of 10 nets perpendicular to the shore) in 2014 (09-10 July 2014), with chains of 10 nets fished at six sites (A, C, D, E, F, J) for one night each. In total, 47 eels were caught with a catch per unit effort (CPUE) of 0.78 eels/net/night (Table 10.1). The eels average length was 41.5cm and ranged in length from 30.6cm to 54.8cm, with a total weight of 6.37kgs caught in the two nights. None of the catch was PIT tagged and no previously tagged eel were taken.

Lough Furnace, the tidal lough, has a surface area of 125ha north of Nixon's Island and 16ha between Nixon's Island and the mouth of the estuarine river ('Back of the House'). The main lough has a maximum depth of 21.5m. Furnace is heavily stratified with significant areas of deoxygenated water in the main basin. L. Furnace was fished in the traditional style (sets of 10 nets perpendicular to the shore) in 2014 (16-17 July 2014), with chains of 10 nets fished at six sites (A, B, C, D, E, F) in one night each and one night (23 July 2014) with two chains of nets at the Back of the House which is a shallow tidal area between the lough and the estuarine river.

In L. Furnace, 76 eels were caught with a catch per unit effort (CPUE) of 1.27 eels/net/night (Table 10.1). The eels average length was 41.6cm and ranged in length from 30.4cm to 78.0cm, with a total weight of 12.0kgs caught for the 2 nights (Table 10.1).

In the Back of the House, 47 eels were caught with a catch per unit effort (CPUE) of 2.35 eels/net/night (Table 10.1). The eels average length was 45.0cm and ranged in length from 21.9cm to 78.0cm, with a total weight of 5.05kgs caught.

Table 10-1: Catch details of the yellow eel survey carried out in 2014.

Lake	Dates	No. Eels	Net* Nights	CPUE	Total weight (kg)	Mean length (cm)	Mean weight (Kg)
Bunaveela	03/07/2014	11	30	0.37	2.13	47.3 (35.7-61.1)	-
	2014	**11**	**30**	**0.37**	**2.13**	**47.3 (35.7-61.1)**	**-**
Feeagh	09/07/2014	25	30	0.83	2.99	40.0 (30.6-49.0)	0.115
	10/07/2014	22	30	0.73	3.38	43.2 (35.4-54.8)	0.147
	2014	**47**	**60**	**0.78**	**6.37**	**41.5 (30.6-54.8)**	**0.130**
Furnace	16/07/2014	61	30	2.03	9.03	41.6 (30.4-78.0)	0.143
	17/07/2014	15	30	0.50	2.97	41.4 (32.4-52.8)	0.125
	2014	**76**	**60**	**1.27**	**12.00**	**41.6 (30.4-78.0)**	**0.140**
BOH	23/07/2014	47	20	2.35	5.05	45.0 (21.9-78.0)	0.183
	2014	**47**	**20**	**2.35**	**5.05**	**45.0 (21.9-78.0)**	**0.183**

* Net (pair of traps)

10.4.2 *Anguillicola crassus*

Anguillicola crassus is an indigenous parasitic nematode of the Japanese eel *Anguilla japonica* in Asia. *A. crassus* does not cause serious pathological damage in its natural host. However, infections in European eel are potentially more serious and can cause damage to the swimbladder with associated bacterial damage, red and swollen anus, as well as, in most severe cases, the collapse of the swimbladder lumen.

A. crassus was introduced into Europe in the early 1980s and it has since spread widely and has successfully colonized most European countries. It was first recorded in Ireland (Waterford Harbour) in 1997. Later records came from the Erne catchment in 1998 and it is now present in approximately 74% of the wetted area of Ireland. The most likely infective route to Ireland was the commercial eel trade although localised spread can be through natural eel movements and paratenic hosts.

The Burrishoole catchment remained free of the parasite until recently. In the fyke net survey in 2012, samples of yellow eels captured in L. Furnace (saline) and at the Back of the House (tidal lough below L. Furnace) were found to be infected with *A. crassus*. Samples of yellow eels from L. Feeagh were negative and a comprehensive sample of silver eels from the traps was also negative indicating that in 2012 the infection seemed to be confined to the tidal lough. This was somewhat surprising as a number of environmental factors have been shown to influence *A. crassus* infections. High salinity has been shown as having a negative impact in the egg hatching and larvae survival of the parasite although the effects of water salinity remain unclear as various surveys have shown no differences in infection levels in waters with different salinity values.

Examination of previous samples would indicate that the parasite was likely to have been introduced into L. Furnace in 2010 or early 2011 (Table 10.2).

The infection intensity in L. Furnace eels continued to rise in 2014. To date it has not been recorded in the freshwater catchment above the fish traps, although in 2014 the parasite was found in 57% of yellow eels sampled in the Mill Race upstream from L. Furnace up to the Fish Fence, and in 18% of the eels between the Fish Fence and the outflow from L. Feeagh possibly indicating that upstream migrating eel are likely to carrying the parasite.

Table 10-2: Location and sample details for eels in Burrishoole examined for the presence of *Anguillicola crassus*.

Year	Location	No. of eels checked	Stage	No. Infected	Prevalence	Intensity
Freshwater						
2009	Traps	50	Silver	0	0	0
2010	Yellow R.	5	Yellow	0	0	0
2010	Black Lakes	3	Yellow	0	0	0
2010	Glenamong R.	3	Yellow	0	0	0
2010	Feeagh	2	Yellow	0	0	0
2010	Traps	17	Silver	0	0	0
2011	Traps	50	Silver	0	0	0
2011	Feeagh	30	Yellow	0	0	0
2012	Feeagh	4	Yellow	0	0	0
2012	Traps	168	Silver	0	0	0
2013	Traps	106	Silver	0	0	0
2014	Traps	94	Silver	0	0	0
2014	Mill Race Lwr	7	Yellow	4	57.1	2.25
2014	Mill Race Uppr	11	Yellow	2	18.2	1.00
Saline Water						
2008	Furnace	60	Yellow	0	0	0
2009	Fu Nixons	47	Silver	0	0	0
2010	Furnace	10	Yellow	0	0	0
2010	Fu Nixons	50	Silver	0	0	0

2011	Furnace	4	Yellow	2	50	1.0
2012	BOH	6	Yellow	6	100	2.0
2012	Furnace	10	Yellow	7	70	4.4
2013	Furnace	6	Yellow	6	100	13.5
2014	Furnace	9	Yellow	5	56	17.6

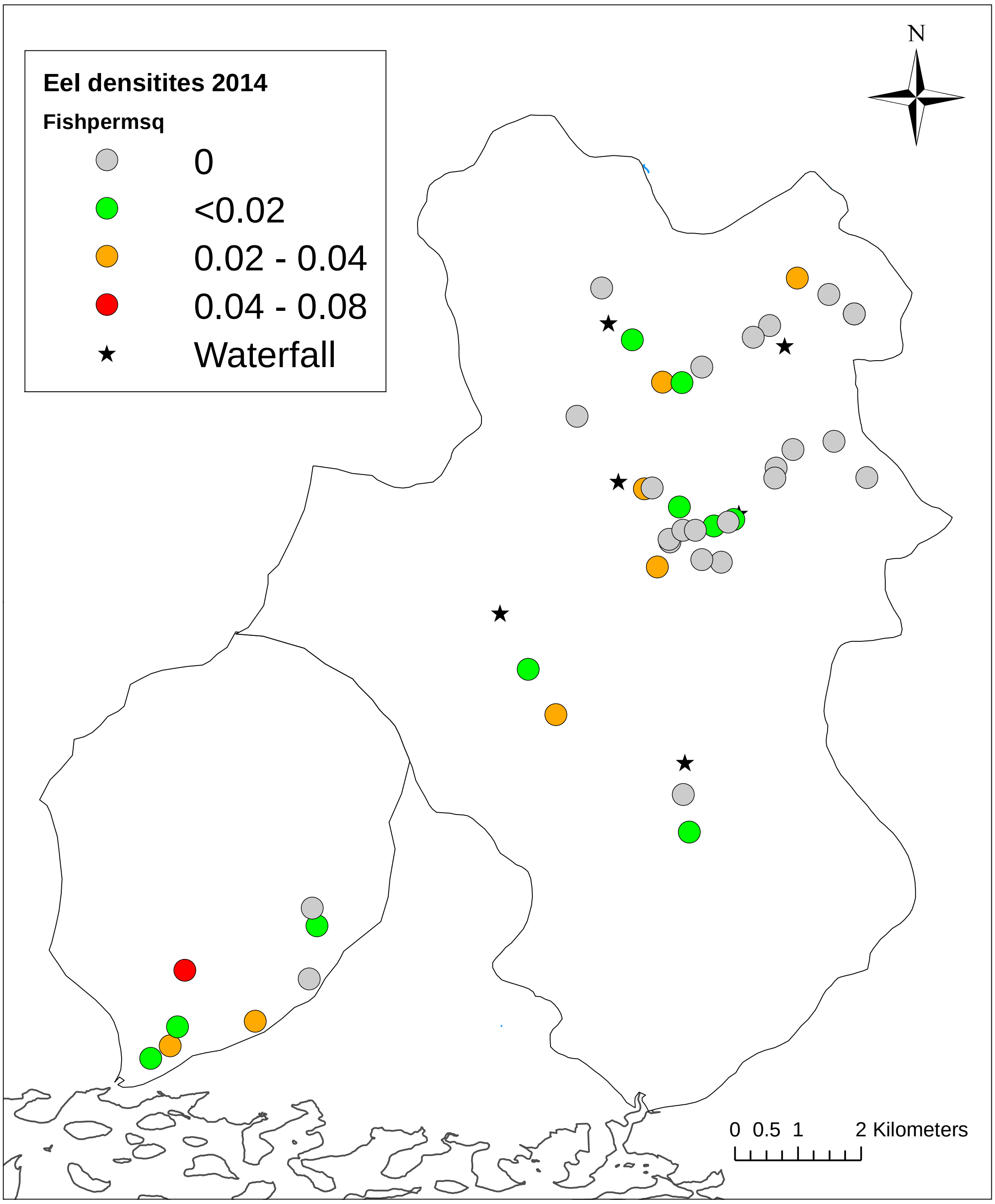


Figure 10-1: Densities of eel calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

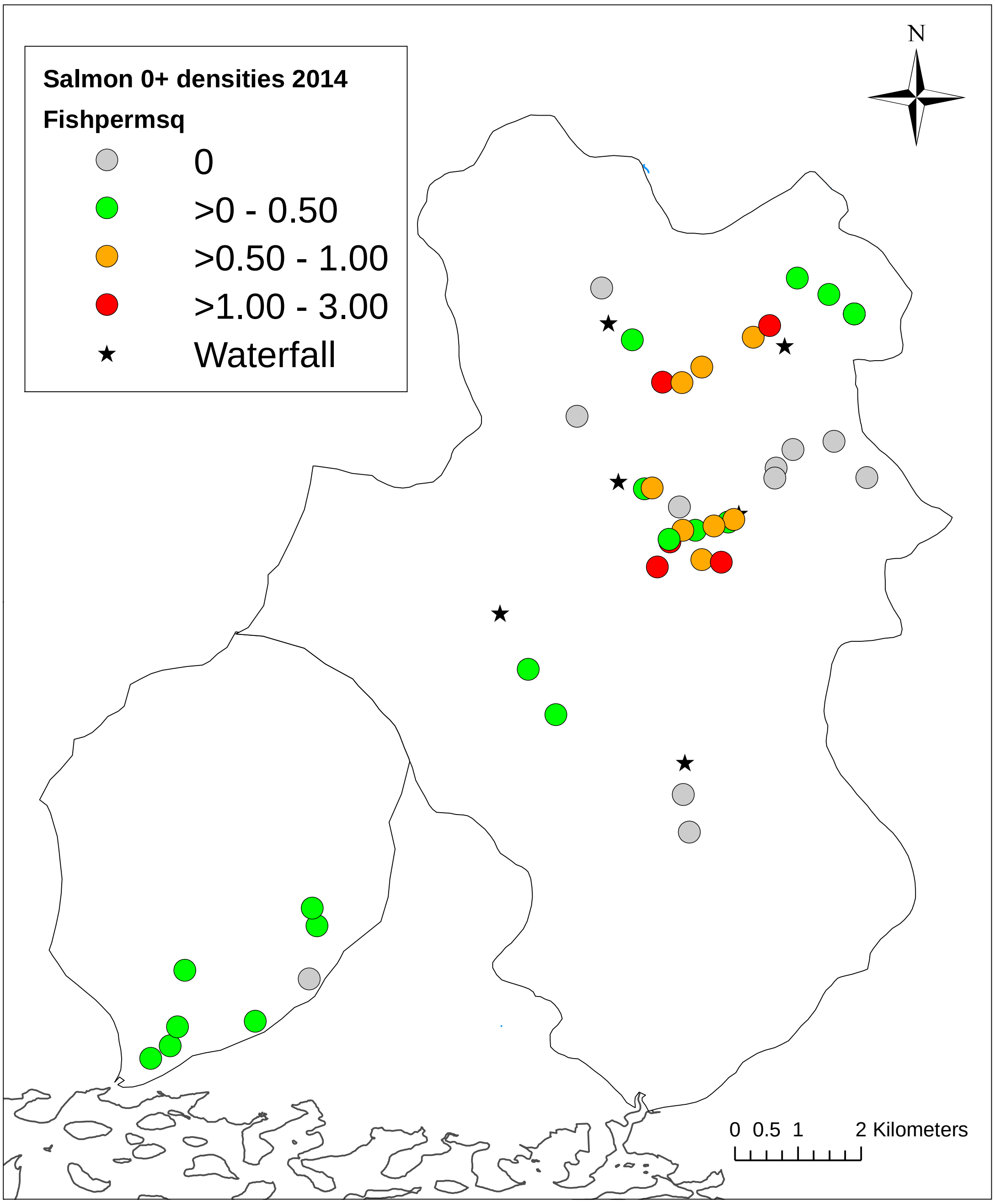


Figure 10-2: Densities of 0+ salmon calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

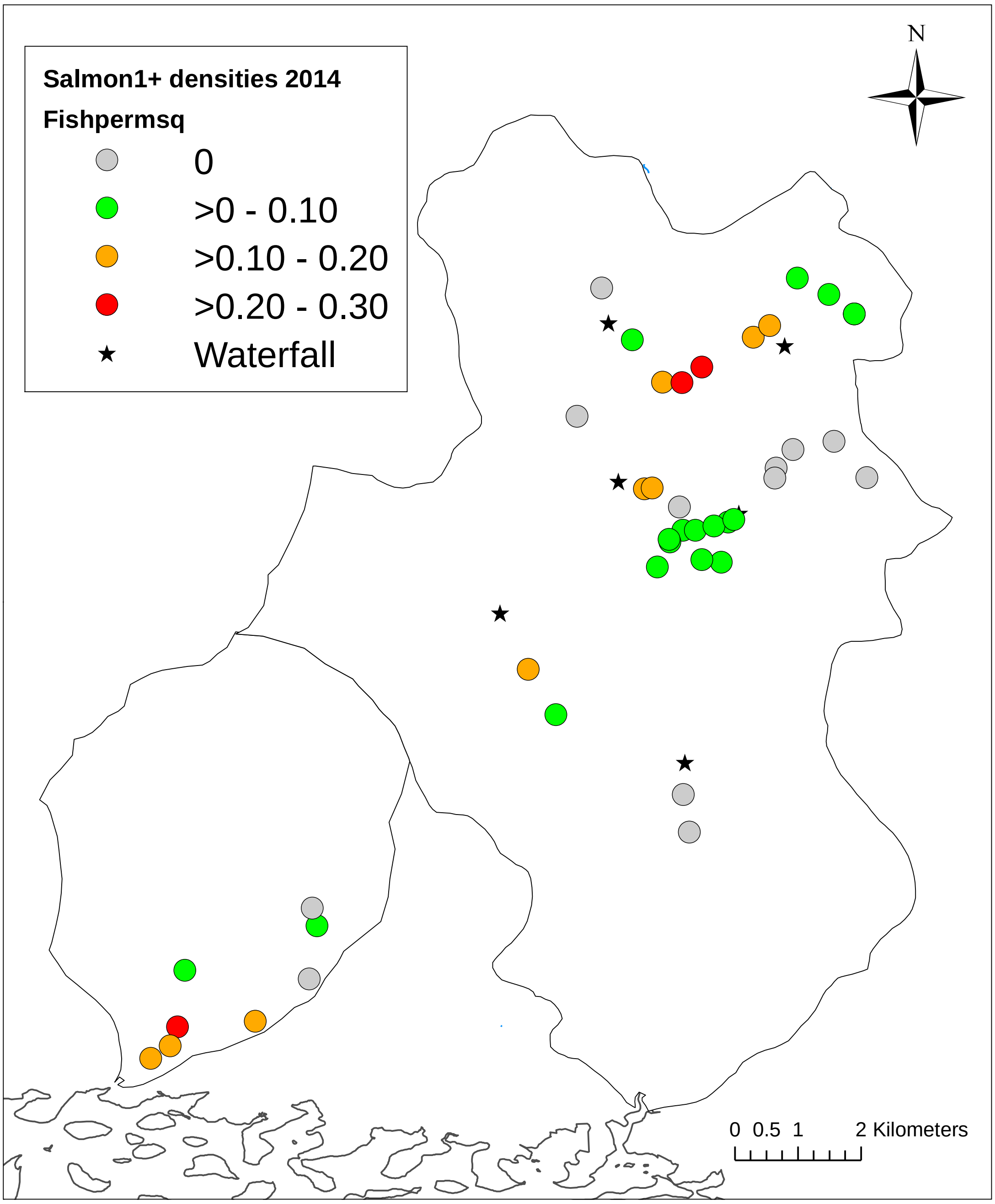


Figure 10-3: Densities of 1+ salmon calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

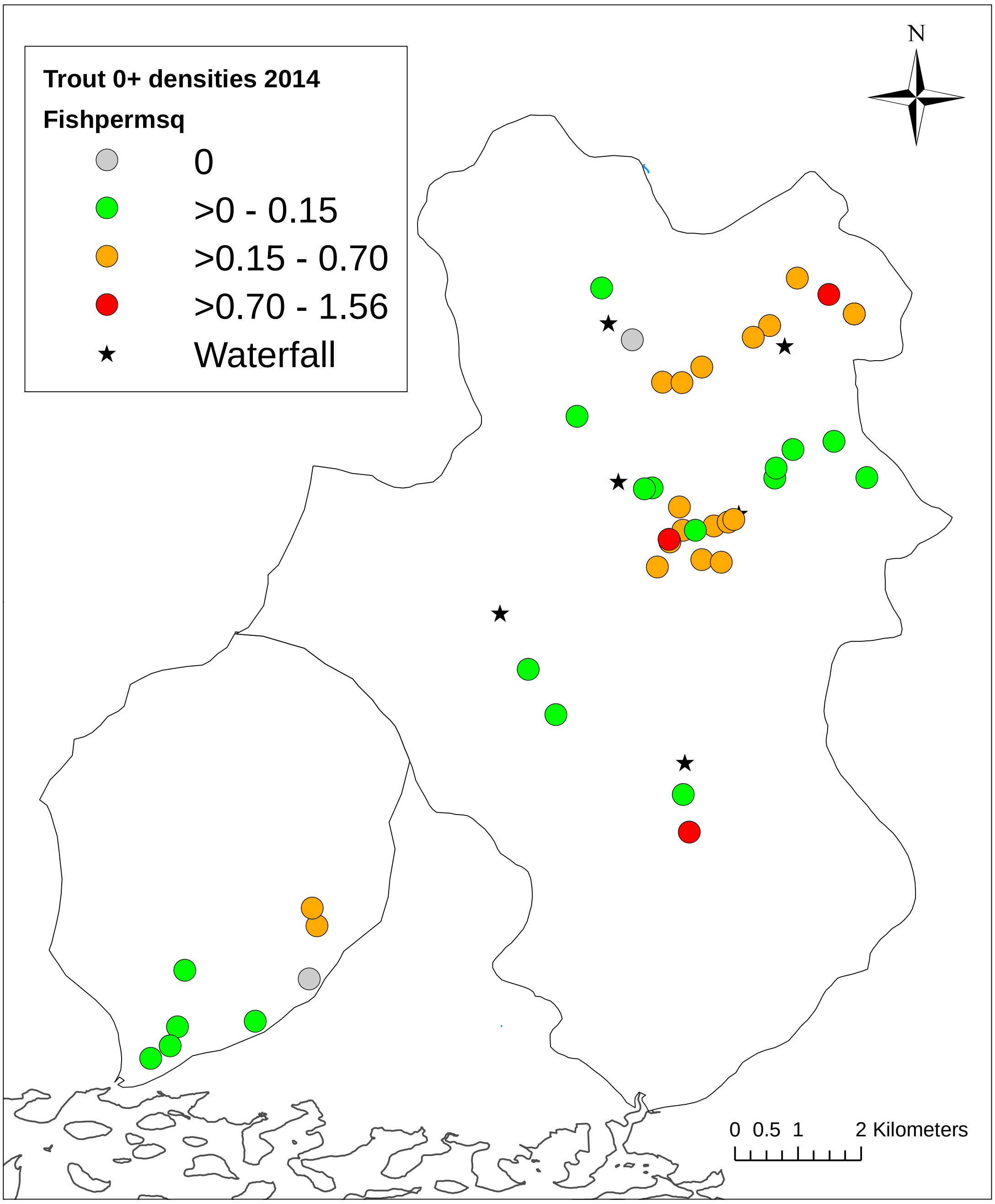


Figure 10-4: Densities of 0+ trout calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

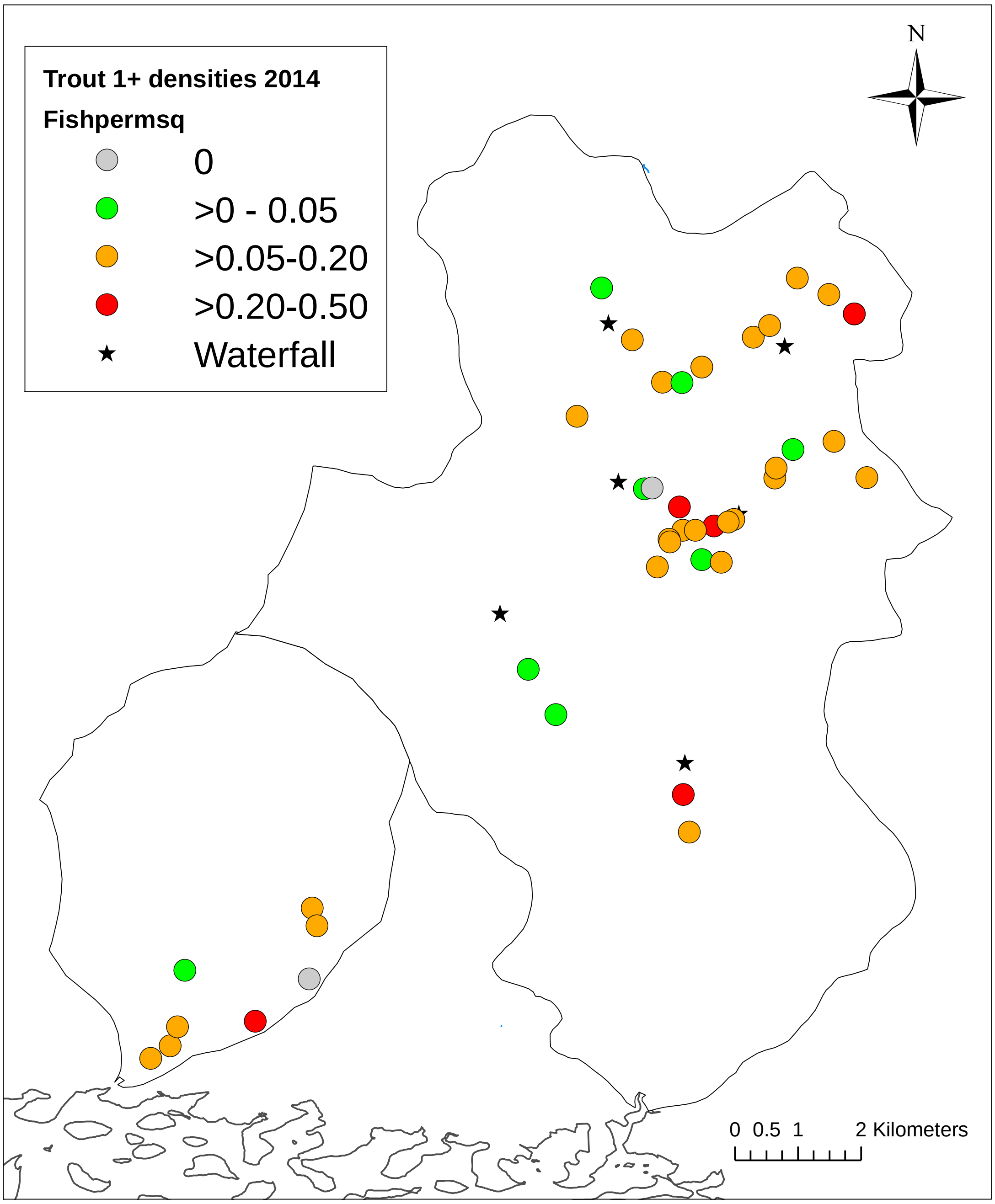


Figure 10-5: Densities of 1+ trout calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

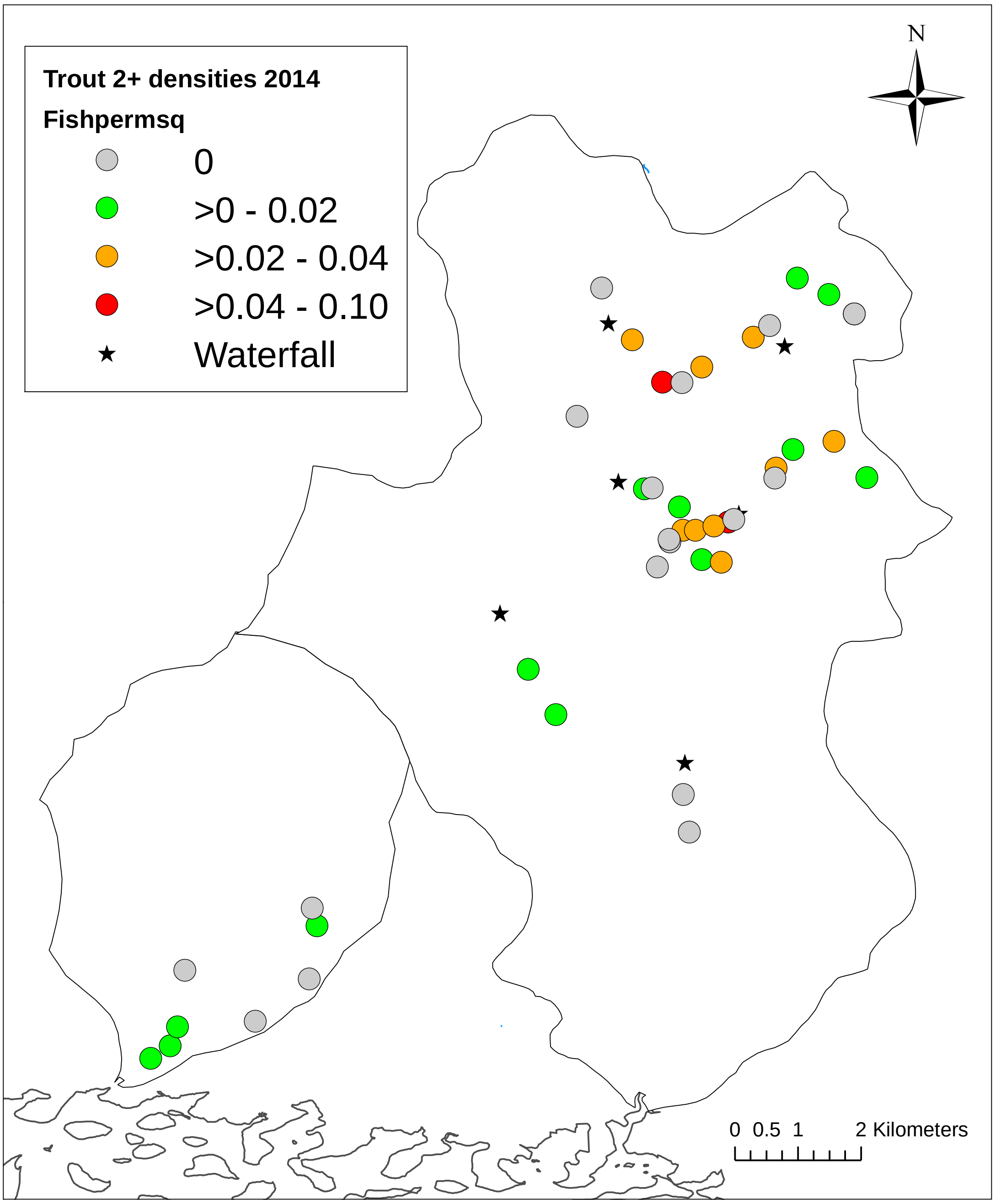


Figure 10-6: Densities of 2+ trout calculated from the 2014 electrofishing survey of the Burrishoole and Owengarve catchments.

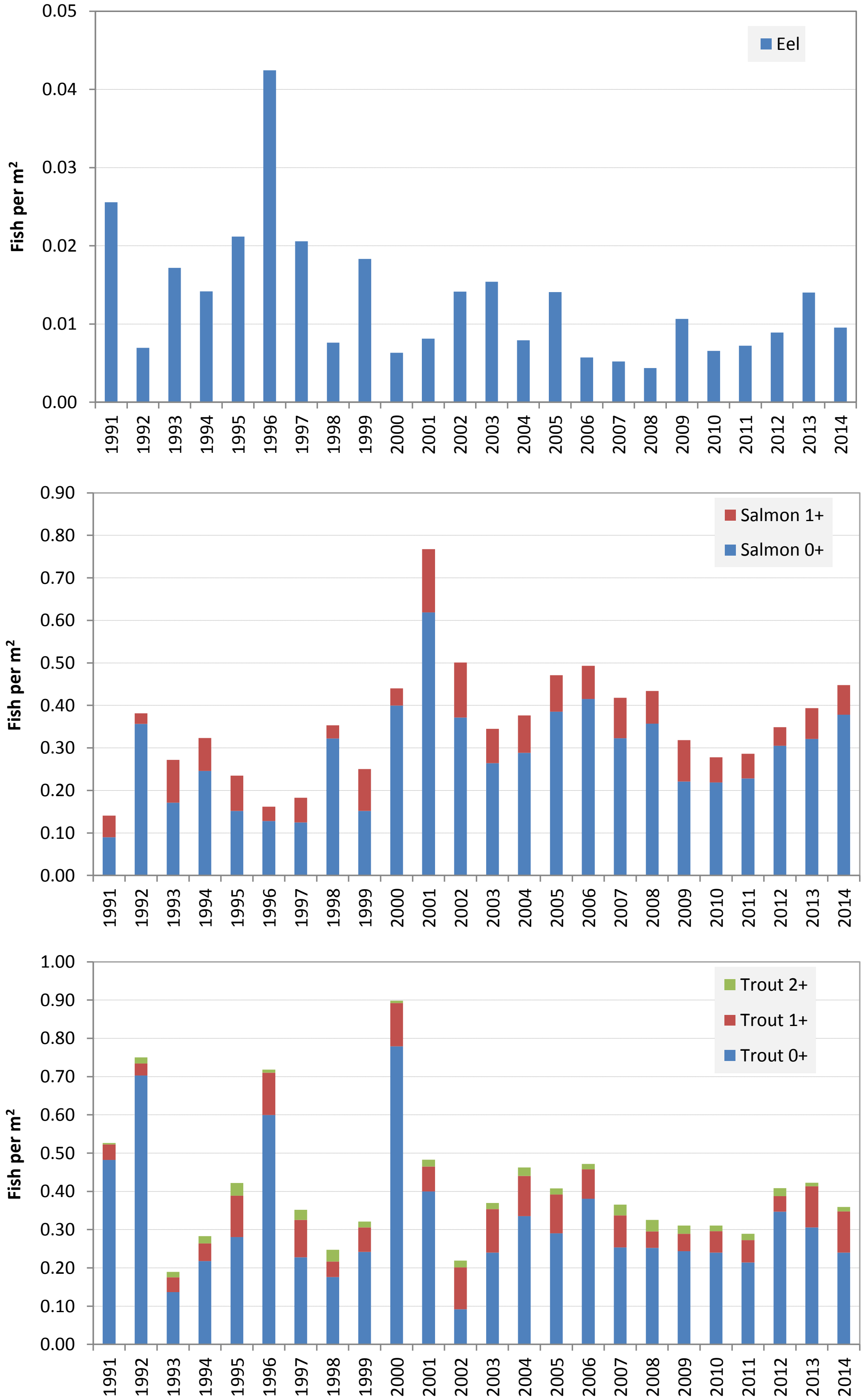


Figure 10-7: Average densities of eel, salmon and trout (fish per m²) calculated from electrofishing surveys of the Burrishoole and Owengarve catchments, 1991-2014.

10.5 Long-term biological monitoring in the Burrishoole catchment

Macroinvertebrate surveys of 16 index sites were conducted in 2014. 316 individuals from 48 samples were counted and identified, and are recorded in the Catchment Macroinvertebrate Access database for future analysis. Zooplankton and phytoplankton surveys of Feeagh and Furnace were continued in 2014, with monthly samples being collected using standard methods, and preserved for future enumeration and identification. Zooplankton sample enumeration for Feeagh and Furnace is up to date.

11 Publications

11.1 Peer-review

Aykanat, T., Johnston, S. E., **Cotter, D**., Cross, T. F., **Poole, R**., Prodohl, P. A., Reed, T., **Rogan, G**., McGinnity, P. & Primmer, C. R.(2014). Molecular pedigree reconstruction and estimation of evolutionary parameters in a wild Atlantic salmon river system with incomplete sampling: a power analysis. *Bmc Evolutionary Biology*, 14**,** 17.

Beccera-Jurado, G., Cruikshanks, R., O'Leary, C., Kelly, F., **Poole, R**. & Gargan, P. (2014). Distribution, prevalence and intensity of *Anguillicola crassus* (Nematoda) infection in *Anguilla anguilla* in the Republic of Ireland. *Journal of Fish Biology* **84;** 1046-1062.

Dalton, C., B. O'Dwyer, D. Taylor, **E. de Eyto**, E. Jennings, G. Chen, **R. Poole, M. Dillane**, and P. McGinnity. 2014. "Anthropocene Environmental Change in an Internationally Important Oligotrophic Catchment on the Atlantic Seaboard of Western Europe." *Anthropocene* 5: 9–21.

Fealy, R., Allott, N., Broderick, C., et al. (2014) RESCALE: Review and Simulate Climate and Catchment Responses at Burrishoole. 426 pp. Galway.

Hamilton, D.P, Carey, C.C, Arvola, L., Arzberger, P., Brewer, C., Cole, J.J., Gaiser,E., Hanson, P.C., Ibelings, B.W., Jennings, E., Kratz, T.K., Lin, F.P., McBride, C.G., de Motta Marques, D., Muraoka, K., Nishri, A., Qin, B., Read, J.S., Rose, K.C., **Ryder, E.,** Weathers, K.C., Zhu, G., Trolle, D. and Justin D. Brookes, J.D. A Global Lake Ecological Observatory Network (GLEON) for synthesising high-frequency sensor data for validation of deterministic ecological models. Inland Waters (2014) 5, pp. 49-56.

O'Driscoll, C**., E. de Eyto**, M. Rodgers, M. O'Connor, Z.-u.-Z. Asam, M. Kelly, and L. Xiao. 2014. "Spatial and Seasonal Variation of Peatland-Fed Riverine Macroinvertebrate and Benthic Diatom Assemblages and Implications for Assessment: A Case Study from Ireland." *Hydrobiologia* 728: 67–87.

O'Driscoll, C., M. O'Connor, Z.-u.-Z. Asam, **E. de Eyto**, M. Rodgers, and L. Xiao. 2014. "Creation and Functioning of a Buffer Zone in a Blanket Peat Forested Catchment." *Ecological Engineering* 62: 83–92.

O'Driscoll, C., M. O'Connor, **E. de Eyto, R. Poole**, M. Rodgers, X. Zhan, M. Nieminen, and L. Xiao. 2014. "Whole-Tree Harvesting and Grass Seeding as Potential Mitigation Methods for Phosphorus Export in Peatland Catchments." *Forest Ecology and Management* 319: 176–85.

O'Driscoll, C., O'Connor, M., Asam, Z. U., **de Eyto, E**., **Poole, R**., Rodgers, M., Zhan, X. M., Nieminen, M. & Xiao, L. W. (2014). Whole-tree harvesting and grass seeding as potential mitigation methods for phosphorus export in peatland catchments. *Forest Ecology and Management*, 319**,** 176-185.

Melia, P., Crivelli, A.J., Durif, C., **Poole, R**. & Bevacqua, D. (2014). A simplified method to estimate body growth parameters of the European eel *Anguilla Anguilla*. *Journal of Fish Biology*, doi: 10.1111/jfb.12486, online at wileyonlinelibrary.com.

Otero, J. *et al* (45 authors inc. **Russell Poole, Ger Rogan & Mary Dillane**). (2014). Basin-scale phenology and effects of climate variability on global timing of initial seaward migration of Atlantic salmon (*Salmo salar*). *Global Change Biology* **20**;B 61-75.

Ryder, E., E. de Eyto, M. Dillane, R. Poole, and E. Jennings. 2014. "Identifying the Role of Environmental Drivers in Organic Carbon Export from a Forested Peat Catchment." *Science of The Total Environment* 490: 28–36.

Ryder, E., **de Eyto, E, Dillane, M., Poole, R**. and Jennings, E. 2014. High resolution monitoring provides greater insight into the environmental factors that drive carbon export. Science of the Total Environment. 490, 28–36.

Walker, A. M., Feunteun, E., Metcalfe, J., **Poole, R.** & Righton, D. (2014). EU eeliad: anguillid eels: conserving a global fishery. *Ecology of Freshwater Fish,* 23**,** 1-1.

White, P., McHugh, B., Poole, R., McGovern, E., Behan, P., Foley, B. & Covaci, A. (2014). Application of congener based multi-matrix profiling techniques to identify potential PCDD/F sources in environmental samples from the Burrishoole Catchment in the West of Ireland. *Environmental Pollution*, **184**; 449-456.

11.2 Grey Literature, Reports, Theses

Ryder, E. (2014). Estimating carbon pools and processing in a humic Irish lake. PhD Thesis, Dundalk Institute of Technology; 188pp + appendices.